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Tools.

THE IMPORTANCE of having good tools and having them in good repair is evident in almost any kind of construction and railway work is no exception to the rule. Poor tools are a bad investment, for the amount of work accomplished with them is undoubtedly smaller and the quality of work done is inferior; also it is evident that they will not last as long as those of a better quality. When it is considered that a tool must be used probably a number of years, first cost should be a secondary consideration to efficiency. For example, a poorly designed claw bar, one with the claws dulled or chipped off, or one which has been carelessly repaired or tempered, generally requires in use an extra man with a hammer to drive the claws under the spike head. And in addition to the extra labor required, there is excessive battering and early destruction of the claw bar. Spike maul handles are liable to be broken very frequently in case an unskilled laborer is used for a hammer man, and since in relaying track the best spikers are generally needed to spike the rails, the hammer men usually are inexperienced and unskilled.

It is undoubtedly true that a good many spikes which were poorly driven cannot be withdrawn without the use of both the claw bar and hammer. On the other hand nearly all properly driven spikes can be withdrawn by willing, expert men with first-class bars, without the use of a hammer. In one instance a gang when relaying used only two hammer men with six claw bars, the joint spikes having been withdrawn in the preliminary work. These men worked alternately wherever an obstinate spike was encountered. In this particular case work was not delayed, and it is readily seen that there was a saving of four laborers. It was also noted that the claw bars stayed in much better shape. This was because the claws were not subject to the wear occasioned by being driven under the spikes with the mauls. The above is a case where the number of laborers was reduced by having good tools. The efficiency of a tool itself will cause an increase in the amount of labor accomplished per man, and if this increase is only 5% over that of a poor tool (and that is certainly a small estimate in many cases) the increased cost of a good one would soon be balanced. This is especially true of tools which are used every working day of the year.

Given good tools it is of great importance to use them carefully, and to repair or have them repaired promptly. In a large gang it is advisable to have one man responsible for the condition of tools, and to carefully keep count and prevent their loss. Such a man if he be intelligent and experienced can more than earn his salary in increased amount of work accomplished, reduction of loss and avoidance of delay to the gang due to lack of necessary tools.

New Use For Furnace Slags.

ON ANOTHER PAGE there is published a series of tests and results of the use of furnace slags in concrete. This calls to mind the rapid progress which civilization is making in the use of what were formerly called "waste products." Slag may hardly be called a waste product since its extensive use in the manufacture of Portland Cement, and the series of tests mentioned seem to show conclusively that as an aggregate for concrete it is equal to any in strength.

The use of slag in making Portland Cement while exten-

sive, has taken but a small part of the product; considerable use has also been made of this material as ballast, but the supply is enormous, and additional demand will find a ready supply.

PUBLICITY.

A MARKED CHANGE of policy is apparent among the railways with regard to giving information to the public and instruction to employes. With respect to the latter especially, great activity is now being shown. Railways are calling the attention of employes to waste, to better methods, and are appealing to them to economize in the use of the company's property for mutual benefit. This policy is bound to have a beneficial effect in decreased expenses, but more than that, will produce a better feeling between employes and the railways. It has been a common fallacy to think that any railway is a prosperous concern. The public thinks rates are too high, and employes think wages are too low. Needless to say a large amount of property does not necessarily indicate prosperity, but it is so taken by a great many people. Unless a property is earning a comfortable surplus over fixed charges it is not a desirable investment, unless there are latent possibilities of profitable development.

Wasted property is wasted wealth. When valuable property is destroyed by fire there is an economic loss. We say that this loss is covered by insurance, but in reality it is made good by a tax (in the form of insurance premiums) which is in the end borne by the whole people. It is conceded that the reduction of fire waste would result in increased economic wealth and National welfare. Why not extend this to cover needless wastes in railroading, or in any other business?

Recently the Atchison, Topeka & Santa Fe has been making an appeal to employes to save a nickel a day; the Illinois Central has issued a book, the objects of which are to save coal as well as to abate the smoke nuisance; the Chicago & Alton has started a campaign to reduce amount of stolen and lost freight; the Chicago & North-Western has made an appeal, through its excellent employes' magazine and by additional circulars, for greater care, to promote safety and reduce accidents; and this movement has already produced remarkable results. The Pennsylvania is taking the lead by offering employes cash for better and more economical methods.

For the promotion of a better feeling between railway and employe, the employes' magazine is a valuable medium, if used exclusively for the benefit of employes, and not published as a business proposition.

CHINESE RAILWAYS.

The American consul at Hong Kong, China, has furnished the department of commerce and labor with the following facts regarding railways in the Celestial Kingdom:

"Down to the beginning of the present century there were only 300 miles of railway in China, and about 2,000 miles in Japan. They have now reached each about 6,000 miles and, according to competent authorities, China will soon have 10,000 more. The following table shows the progress of railway mileage in the Middle Empire:

	Miles.
1911	6,000
1908	4,500
1904	3,455
1895	300

The possibilities of future railway expansion in China are limited only by the extent to which native and foreign capitalists are willing to share the risks and profits of construction and flotation. Along the Pekin-Hankow line the farmer, whose market was formerly confined to his immediate neighborhood, now has at his command numerous markets for his produce, besides the populous cities at both termini. The Shanghai-Nanking line is transporting Chinese coal and iron to the coast, whence they are being carried in steamships to Japan and the western coast of America. The lines from Chili and Honan, which tap the great cereal regions of Shanse, are laden with wheat and corn which formerly found no outlet beyond the neighboring villages.

Agriculturist and miner are both enriched by these new channels to market, and the local quotations for railway shares and bonds prove that China has capital of its own, and that buried hoards are being attracted to the Hong-Kong stock market. Following is a list of the principal lines:

Railway Mileage of China.

Amoy-Changchow	40
Canton Kowloon	125
Canton-Woochang (Hankow), 720*	150
Cheng-Taiyuan	170
Honan-Tungkwan	130
Kaifeng-Honan	136
Kikiang-Nanchang	76
Langson-Namkuan-Lungchow	46
Lao-Kai-Yunnan	127
Nanchow-Kiukiang	95
Pachili, to the Sangary river	370
Pekin-Newchwang-Mukden	600
Pekin-Hankow	754
Pekin-Kalgau, 275*	150
Ping-siang (Siang river)	56
Shanghai-Nanking	192
Shanghai-Ningpo	190
Shanghai-Wusung	12
Sunning Railway in Quangtung	40
Swatow-Chau Chau	32
Swatow-Chenghai, 75	25
Taokou, in Honan, to Chinghau, in Shanse	90
Tientsin-Pukow, Nanking, Northern section	400
Tientsin-Pukow, Nanking, Southern section, 275*	...
Tsintau-Tsinan	247
Wahu-Kwangti	113
Manchurian Lines.	
Harbin-Suefenho	462
Manchurian frontier to Dalny	1,180
Total mileage completed	6,008

Projects of considerable magnitude under the best Chinese auspices are increasing rapidly. The consul reports that a company is in course of formation with a capital of about $8,000,000 gold, to build a railway from Sum Chun on the Canton-Kowloon line to Tamshut, Haifung, Lukfung, Hui Lai, Puning, Kityang and Chowchowfu, and thence by the existing line to Swatow. Eventually it will be extended to Amoy and to Foochow. A light railway from Swatow to Chenghai, to cost about $150,000, is also proposed.

The Central R. R. of New Jersey is reported to be planning the construction of a new bridge across the Lehigh River in the vicinity of Glen Onoko, Pa., providing a straight roadway at that place. At present the road uses a rock tunnel which it desires to eliminate on account of the danger of falling rocks.

*Under construction.

Concrete in Railway Construction

Compiled from data furnished by the Atlas Portland Cement Company.

Continued from page 336. (July Issue.)

CHAPTER V.

Piers and Abutments.

Piers.

Concrete is employed for bridge piers either as filling for ashlar or cut masonry, or for the entire pier, in which case it may be of either plain or reinforced concrete. When of plain concrete, the sizes and general proportions are practically the same as for stone piers, the quantity of masonry used for the two not differing materially. If reinforced concrete is used, there may be quite a saving of concrete with a corresponding reduction in the cost of the structure. This is obtained either by reducing the size of the pier or by using the ordinary size of pier and making it hollow with reinforced walls, in which case the open space is either filled with sand, broken stone or gravel, or if the pier is designed so that it possesses sufficient stability it is left open, thus making a considerable reduction in the load on the foundation. The top slab forming the coping is designed strong enough to support the loads brought upon it and transmit them to the side and interior walls, which in turn carry the loads to the foundation.

Standard Piers, N. Y. C. & H. R. R. R.—The standard pier of this railroad is adapted to any height up to 40 feet.

The width, which is dependent upon the length of span, is as follows:

Spans up to 40 feet width, A, = 4 feet 0 inches.
Space 40 to 60 feet width, A, = 4 feet 6 inches.
Spans 60 to 80 feet width, A, = 5 feet 0 inches.
Spans 80 to 100 feet width, A = 5 feet 6 inches.
Spans 100 to 125 feet width, A, = 6 feet 0 inches.
Spans 125 to 150 feet width, A, = 6 feet 6 inches.
Spans 150 to 200 feet width, A, = 7 feet 0 inches.
Spans 200 to 250 feet width, A, = 7 feet 6 inches.

The foundation which is of 1:3:6 concrete, except where local conditions make stone cheaper, is varied to suit local conditions, but is not less than 4 feet deep unless good rock is found. The pier itself is constructed of 1:3:6 concrete while the coping, which is reinforced with galvanized wire netting or wire cloth is of 1:1:2 concrete, as is the starkweather cap which is two feet above high water.

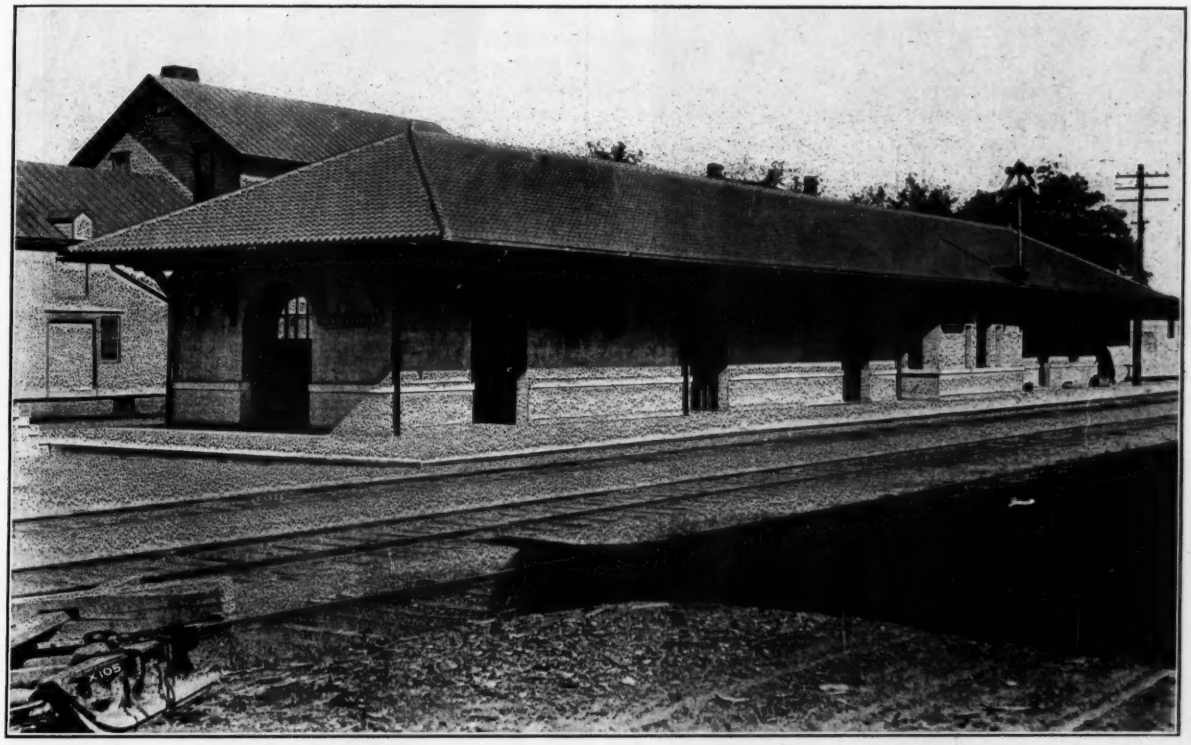


Fig. 24. Marathon Station, D., L. & W. R. R.

Raising Grade of Old Masonry Piers.—The photograph in Fig. 19 shows a three-span plate girder bridge on the Chicago, Milwaukee & St. Paul Railway which originally rested on piers and square wing abutments of cut stone across which the grade was raised 7½ feet by means of concrete. The girders were raised to grade and the concrete built in place, the rounded ends being formed by means of steel shells held in place by rods which were left in the concrete to give additional strength to the piers. A short span was added at either end of the bridge to take the slope and a rectangular concrete pier of the proper height to bring the masonry up to grade was built on each abutment.

Abutments.

Plain Abutments. Abutments for bridges can be designed of either plain or reinforced concrete. When plain concrete is used the general details are essentially the same as those

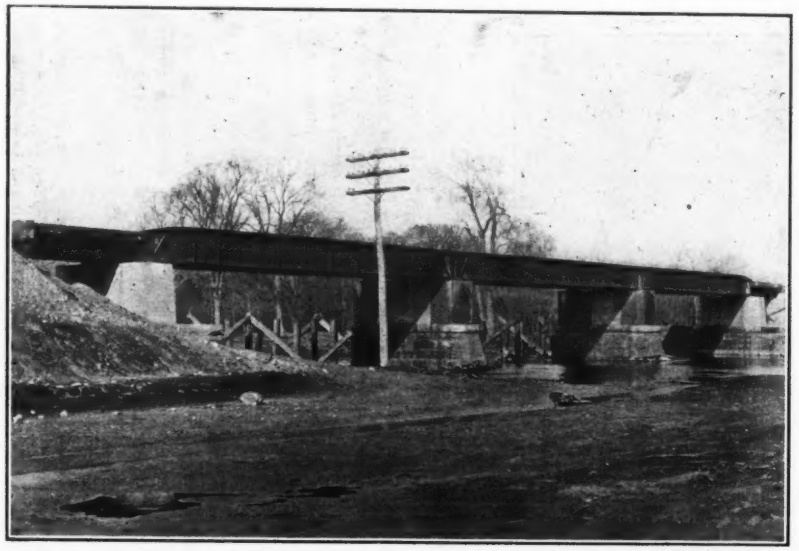


Fig. 19. Concrete Used to Raise Grade of Old Masonry Piers, C., M. & St. P. Ry.

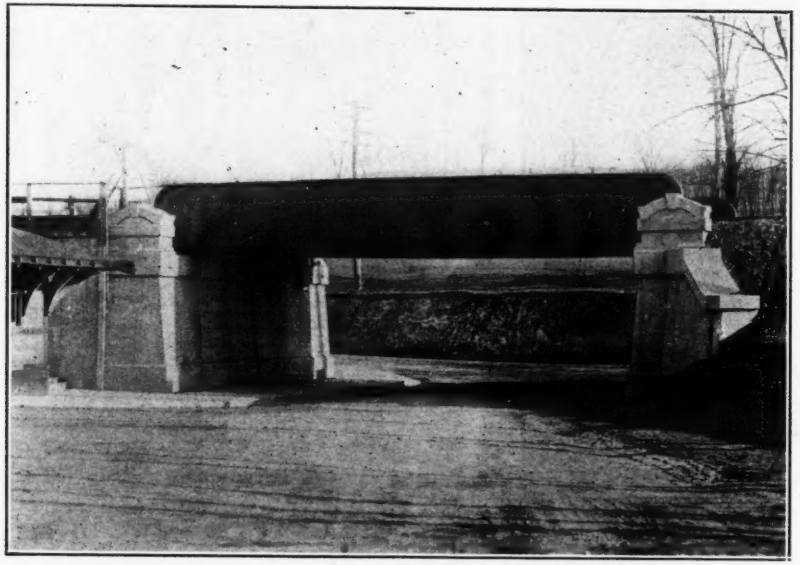


Fig. 20. Van Cortland Ave. Abutments, N. Y. C. & H. R. R. R.

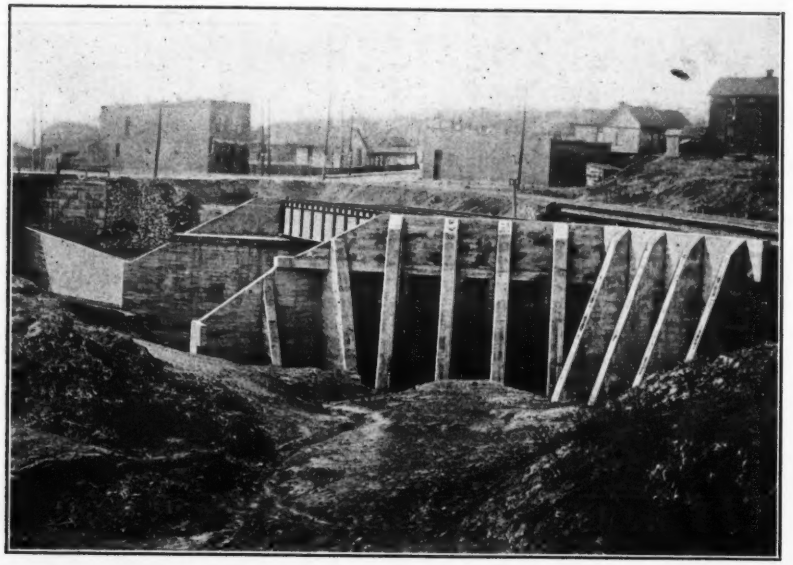


Fig. 21. Street Abutments before Filling, K. C., M. & O. Ry.

Fig. 23. Buffalo Retaining Wall, D., L. & W. Ry.

employed for stone abutments. The Van Cortlandt avenue abutments on the N. Y. C. & H. R. R. R., shown below, are fine examples of this type, not only as to details of construction, but also on account of the architectural treatment of the design.

Reinforced Abutments. By using reinforced concrete there is generally a considerable saving in materials which in some instances has been so great as to reduce the cost as much as 40 per cent. Fig. 21 is an example of reinforced abutment on the K. C., M. & O. Ry.

The bridge seat consists of a heavy reinforced concrete slab extending over the tops of the supporting buttresses, thus securely knitting the structure together. These supporting buttresses are located directly under the bridge girders, thus eliminating bending in the slab forming the bridge seat. In designing the buttresses the width must be taken at least equal to that of the bed plate.

In order to resist the overturning moment, vertical bars are placed in the back and extend through the base hooking under the horizontal bars in the bottom. A sufficient number of horizontal bars are placed in the buttresses to transfer the total load from the face wall to the buttresses without depending upon the tensile strength of the concrete. The diagonal shear in the buttresses is taken care of by the diagonal rods which hook under the bottom bars in the rear of the base and over the longitudinal bars in the face wall.

A face wall, heavy enough to resist the earth pressure and live load transferred through the earth, is placed in front of, and constructed monolithic with, the buttresses, the two being firmly tied together by means of the reinforcing bars with hooked ends. This face wall is continued beyond the bridge seats to form wings, and is supported by buttresses at intervals of about 8 feet.

At the back of the bridge seat there is a parapet wall forming the back or mud wall, as in a stone abutment, which is provided with returns at the ends to the face walls and is supported by buttresses similarly to the front wall, and in addition by the vertical bars extending into the bridge seat.

The base consists of a rectangular slab sufficiently reinforced to distribute over the foundation the load transmitted by the buttresses under the bridge seat. Usually, as is the case in the design mentioned above, the width of the base is not taken less than one-half the height of the abutment. To minimize the eccentricity of the load, the base extends about two feet beyond the face wall.

Van Cortlandt Avenue Abutments, N. Y. C. & H. R. R. R. These abutments, which were designed and constructed by the engineering forces of the New York Central Railroad during the fall of 1904, are noteworthy examples of the adaptability of concrete to architectural treatment in structures of this nature, which are frequently crude in the extreme. The photograph in Fig. 20 gives an idea of the artistic effect which is derived from the moulded pylons and the graceful lines of the wing walls.

In the construction of the abutments four different proportions of cement, sand and broken stone were used as follows: Footings 1:4:7½; main wall and wing walls, 1:3:6; bridge seats and pylons, 1:1:2; copings, 1:2:4.

Old rails with joints staggered and bolted together with two angle bars were laid in the footings 12 inches on centers and 6 inches from the bottom. The bridge seats were reinforced with Clinton Galvanized Wire Cloth, 3 by 8-inch mesh No. 10 wire. Each abutment is provided with a 4-inch cast iron down spout which is hidden in a 6 by 8-inch chase in the center of the face of the wall and connects with a 6-inch tile drain on one side and discharges into the gutter on the other.

Third Street Abutments, K. C., M. & O. Ry. These reinforced concrete abutments are on the Kansas City Outer Belt & Electric Railroad, which furnishes an entrance into Kansas City and terminal facilities for the Kansas City, Mexico & Orient Railway, and were designed by Mr. W. Colpitts, assistant chief engineer of the road, and built by Mr. L. J. Smith, general contractor, Kansas City, in the fall of 1906.

With the exception of the bridge seats, which are of 1:2:4, all the concrete was mixed in the proportion of 1 part Portland cement to 3 parts Kansas River sand to 5 parts crushed limestone, passing a 2-inch ring and freed from dust by screening.

Seven-eighths-inch corrugated bars were used for reinforcing throughout the abutments and adjoining retaining walls. All bars were lapped 3 feet with joints broken. The supporting piles extend 6 inches into the base slab and were covered with three inches of concrete before the reinforcing bars were put in place. In both abutments and retaining walls the face walls were trenched six inches into the base slab. The forms were constructed of 1-inch lumber with 2 by 6-inch studs 12 inches on centers and the concrete was mixed by a No. 1 Rotary Mixer.

All excavation and pile driving was done and the reinforcing bars furnished by the railroad company, who also bore one-half the cost of keeping the foundations dry while the forms were being built and the concrete placed.

The following figures give the unit cost to the contractor and the unit cost to the railroad company who let the contract on the basis of $9 per cubic yard, which covered all labor and materials necessary except the items under "unit cost to railroad."

Unit cost to contractor:		
Cement	$1.78	per cubic yard concrete.
Sand	0.35	" " " "
Stone	1.35	" " " "
Lumber	0.74	" " " "
Labor	2.75	" " " "
Miscellaneous	0.16	" " " "
	$7.13	" " " "
Unit cost to railroad:		
Excavation (total)	$3.80	per cubic yard concrete.
Piles (214) 5,228 lin. ft.	1.84	" " " "
Reinforcing bars	1.82	" " " "
	$7.46	" " " "
Total unit cost, not including profit	$14.59	" " " "

CHAPTER VI.

Retaining Walls.

The use of both plain and reinforced concrete for retaining wall construction in track elevation and depression work has become general throughout the country. The plain concrete walls are designed of gravity section, that is, they are made heavy enough so that their own weight prevents them from sliding or overturning. Reinforced walls consist either of a thin vertical wall attached to a horizontal base and braced either by counterforts on the back or by buttresses on the front side, or they are designed as cantilevers, in which case the wall is attached to a spreading base, the whole section being in the form of an inverted T.

Reinforced concrete retaining walls usually are more economical than plain concrete walls, since in the latter type the material cannot be fully utilized because the section must be made heavy enough so that their own weight prevents them from overturning. In reinforced concrete retaining walls, on the other hand, a part of the retained material is used to prevent overturning and the section need be made only strong enough to withstand the moments and shears due to the earth pressure. The wall is lighter and exerts smaller pressure on the soil, which with the possibility of

extending the base of the wall, sometimes enables the constructor to get along with ordinary foundations in cases where for masonry walls piles would have been indispensable. They also admit the use of a more scientific design, since the behavior of reinforced concrete is even better known and more reliable than that of plain concrete.

The common practice among railroad engineers of using arbitrary ratios of width of base to height of walls in designing retaining walls, leads to a neglect of the study of the distribution of the pressure on the foundation. Since it is well established that movements from the original alignment due to unequal settlement cause a defect more common than any other, this question is of great importance and each

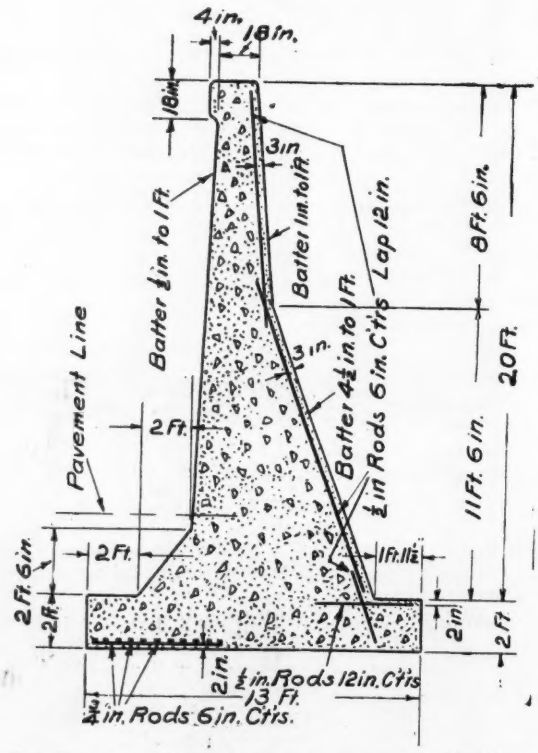


Fig. 22. Cross Section, C., B. & Q. R. R. Retaining Wall.

case should be carefully studied and the amount and distribution of the pressure on the bed or foundation determined.

Also, by a careful analytical treatment, the most effective section and the minimum amount of material will be attained, whereas many of the walls thus far designed have embodied a great waste of material on account of lack of economy in design.

The more economical of the two types of reinforced concrete retaining walls for a specific case depends upon the height of the wall, the intensity of earth pressure and the relative cost of concrete and steel. As a general thing the construction of the inverted-T type is simpler and the placing of the steel easier, requiring less skilled labor and experience. The least height at which the counterfort type may be economical has been found by special studies for this chapter to be in general about 18 feet.

In retaining walls of any considerable length it is necessary to provide against shrinkage and temperature cracks. The general practice for walls of unreinforced concrete is to place contraction joints at intervals of from 30 feet to 50 feet. It is possible to provide enough horizontal reinforcement to so distribute the temperature stresses that the cracks will be very minute and scarcely noticeable. For this, 0.3 per cent of horizontal steel based on the vertical section of the wall is sometimes used and this should be placed near the surface and in small sized rods. It is quite common practice to introduce a smaller quantity of horizontal reinforcement and in addition provide occasional contraction joints to allow for movement and to localize any cracking.

In constructing retaining walls it is of the utmost importance that careful attention be given to the earth filling and to its drainage. The drainage is most easily accomplished by filling close to the back of the wall with some porous material such as gravel, crushed stone or cinders and by placing weep holes through the wall at suitable distances to carry the water from behind the wall. The distance between these weep holes is dependent upon local conditions, and should be decided after careful examination of the ground. The standard retaining wall specifications of a number of railroads call for weep holes not more than 15 feet apart with vertical blind drains extending to the top of the wall.

Reinforced Retaining Walls, C., B. & Q. R. R.—Fig. 22 shows the essential features of design and construction of a typical track elevation retaining wall of the Chicago, Burlington & Quincy Railroad, which is in reality a compromise between the plain monolithic and the cantilever types of walls. In designing, no attempt was made to use the full compressive strength of the concrete, as such a condition would have required a much greater amount of reinforcement and at the same time would have developed an excess of strength beyond requirements. Sections at the top of the footing, at the angle in the back of the wall, and at points both above and below this angle were analyzed and the stresses computed by Prof. Howe's formulas and a sufficient amount of reinforcement was provided to take care of the total tensile strength at every point which, however, was very small because of the comparatively heavy section. Owing to the difficulty in constructing reinforced abutments, plain concrete was used; the footings, however, have a reinforced projection in front to increase the bearing area. As a general thing the walls are supported on piles closely spaced under the toe and more widely apart under the heel. The concrete was mixed in the proportions of 1 part cement to 6 parts pit run gravel.

As the cross section of the wall is such that, in filling, the concrete showed a tendency to lift the forms off the footing, ½-inch bars were placed in the footing and the forms tied to them with wires. The wall forms are tied together by ¾ rods which pass through pieces of 2-inch scrap pipe cut to fit loosely between the forms, the ends of the pipes being stuffed with waste to keep the grout from filling them.

In regard to the cost of walls of this type, Mr. C. H. Cartlidge, Bridge Engineer of the C., B. & Q. R. R., under whose supervision, with Mr. L. J. Hotchkiss, Assistant Bridge Engineer, the walls were designed, writes as follows:

"This wall (reinforced concrete) will show an economy over a gravity wall of solid concrete. The cost of a large amount of work, including everything, has been a little less than $9 per yard. For the concrete only, exclusive of excavation and piling, $6.23 per yard. Our abutments are solid concrete without any reinforcing. These cost us per cubic yard $5.55, including everything. The high cost per yard of the retaining walls for excavation and piling is, of course, due to the fact that comparatively little concrete is used per yard of excavation. The

true comparison, therefore, is between the concrete in the two, being for the retaining walls $6.23 and $5.03."

CHAPTER VII.

Stations, Train Sheds and Platforms.

Railroads throughout the country are adopting the use of concrete in the construction of railway stations of every class, in many cases for the entire structure and in others for integral parts such as foundations, platforms, smoke ducts, stairways, and often for architectural features, such as cornices, belt courses and platform columns. Its permanence, fire resisting qualities and adaptability to architectural treatment renders it a most satisfactory building and structural material for both large and small stations.

Marathon Station, D., L. & W. R. R. This structure, a photograph of the track side of which is shown in Fig. 24, is a combination passenger station and freight house of simple, yet artistic design and substantial construction.

With the exception of the roof, which is of Ludowici Celadon tile on wooden rafters, and the trusses and brackets, the building is of concrete construction throughout. The foundations and main walls are of plain concrete, except over square openings where reinforced lintels are formed by placing three ¼-inch square rods near the soffit, while the floors and platforms are of plain concrete laid directly on a cinder base and surfaced with a 1½-inch granolithic finish.

The walls are tool finished up to the water-table, and above that, with the exception of the belt course, were finished by floating the green concrete with water and rubbing with wire brushes immediately after removing the forms. All the concrete was mixed in the proportions of 1 part Portland Cement to 2 parts sand and 4 parts broken stone.

The station was designed by Mr. F. J. Nies, architect for the railroad, under the supervision of Mr. Lincoln Bush, Chief Engineer, and was built by A. E. Badgely, general contractor, of Binghamton, N. Y.

Train Sheds.

Hoboken Terminal Train Shed, D., L. & W. R. R. The train shed for the new Lackawanna passenger terminal at Hoboken, N. J., is an entirely new departure from the hitherto considered standard type of structure for this purpose. Instead of comprising a series of high arches, which in the common type of train shed are continually enveloped in a haze of smoke and gases from the locomotives, it consists essentially of a system of low arched short span longitudinal sections, just high enough to clear the largest locomotive in use on the line, with smoke ducts of reinforced concrete through which the locomotive gases are discharged directly into the open air. As will be seen from Fig. 25, each of these sections covers two tracks and the sides of the smoke ducts are built high enough to prevent driving rain or snow from reaching the platforms. In additions to the smoke ducts the roof, platforms and fence footings are of concrete construction.

This shed was designed and patented by Mr. Lincoln Bush, Chief Engineer, of the Delaware, Lackawanna and Western Railroad, and erected under his supervision by the company forces in 1907. The same type of train shed has also been used by the Lackawanna Railroad at the new Scranton station and by the Chicago and Northwestern Railway Co. at its new terminal in Chicago.

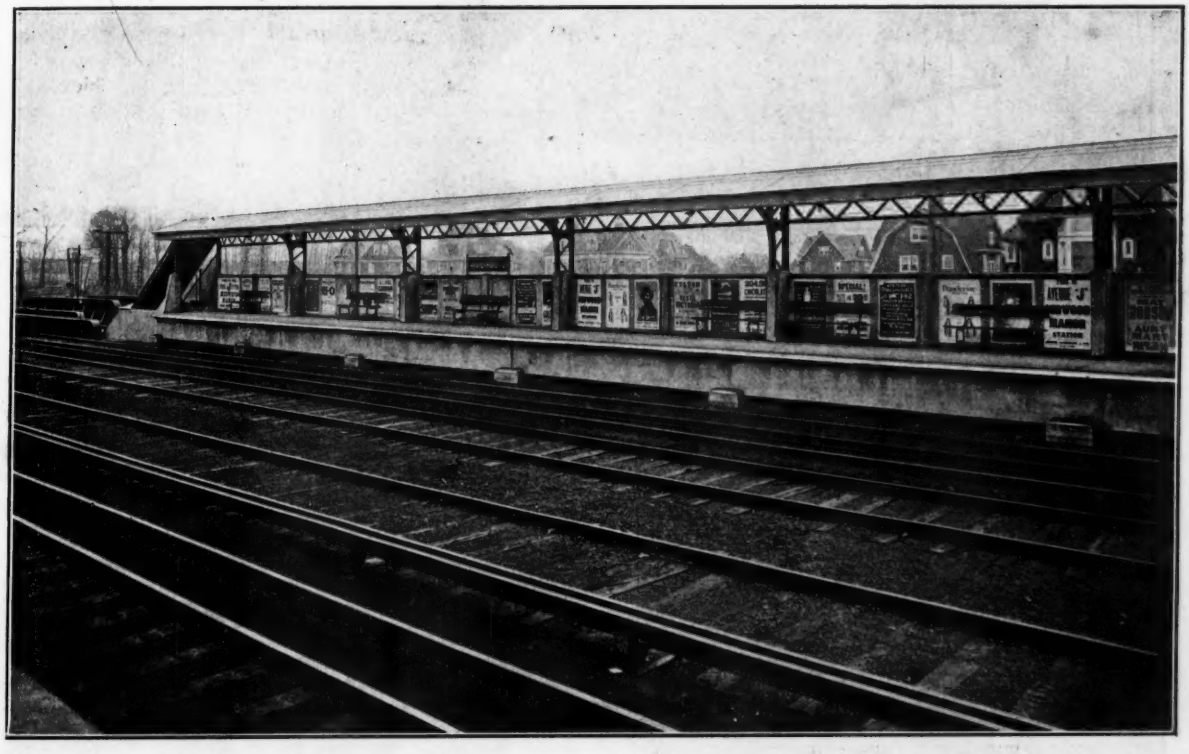


Fig. 26. Suburban Station Platform, Brooklyn Rapid Transit Ry.

Platforms.

While plain concrete has been used for many years in the construction of low platforms at main stations the adoption of high platforms on rapid transit and suburban lines during the past few years has opened up a new field for reinforced concrete.

Station Platforms, Brooklyn Rapid Transit Co.. The platforms on either side of the tracks are about 240 feet long and 8 feet wide and are constructed of a reinforced concrete slab carried by girders of the same material which are in turn supported by concrete piers placed about every 20 feet. The photograph in Fig. 26 shows the track side of one of the platforms.

Fig. 28. Coaling Station, Pollack, Pa., P. & L. E. R. R.

Fig. 25 Hoboken Terminal Train Shed, D., L. & W. R. R.

Fig. 27. Coal & Sand Station, N. & W. Ry.

Expansion joints are provided every 60 feet by separating the construction entirely with tarred paper. The outside edges of the platform are equipped with patent bulb nosing. The fences running the length of the platform and forming the guard railings on the outside and ends of the platforms are constructed of cement plaster on metal lath.

For the concrete work a mixture of 1 part Portland cement to 2 parts sand to 4 parts ¾-inch broken stone was used throughout. The 1-inch granolithic surface of the platforms was mixed in the proportions of 1 part Portland cement to 1 part sand and 1 part pebble grit and was applied simultaneously with the last course of concrete.

In designing the platforms, a live load of 150 pounds per square foot was assumed and the concrete was figured at 500 pounds per square inch extreme fiber stress while the steel was allowed 16,000 pounds per square inch in tension.

The platforms were designed by the Engineering Department of the Brooklyn Rapid Transit System, Mr. W. S. Menden, Chief Engineer, and were constructed under his supervision by Mr. Thomas G. Carlin of Brooklyn, in 1907.

Electric Zone Standard Platforms, N. Y. C. & H. R. R. R. One of the most important features of the Electric Zone improvement work of the New York Central and Hudson River R. R. is the adoption of high platforms on the suburban side of all local stations within the Zone. This not only enables greater ease in the interchange to and from trains, but greatly increases the rapidity of the service.

The type adopted comprises two longitudinal reinforced 8-inch walls with a 6-inch reinforced deck or floor plate spanning the walls and overhanging 2 feet 6 inches on either side. The width varies from 12 to 15 feet, while the height is four feet above the rails on tangents and curves up to three degrees and thirty minutes. For sharper curves the platforms are made proportionately lower.

In plan the arrangement of the platform varies greatly according to the location. The suburban stations have high platforms about 350 feet long, on either side, outside of the group of four tracks, and the combination stations have two high outside platforms and a middle low platform between the express tracks on both sides, with a high platform at one end for a distance of 350 feet and a low one of the same length adjoining it. All stations are provided with overhead bridges or subways connecting with the various platforms.

The concrete is of 1:3:6 proportions, with exposed surfaces faced with ½-inch cement finish mixed in the proportions of 1 cement to 1½ sand. All exposed edges are rounded to a 1-inch radius. The platforms are divided into blocks of not more than 40 square feet area and expansion joints are to be provided every 25 to 40 feet.

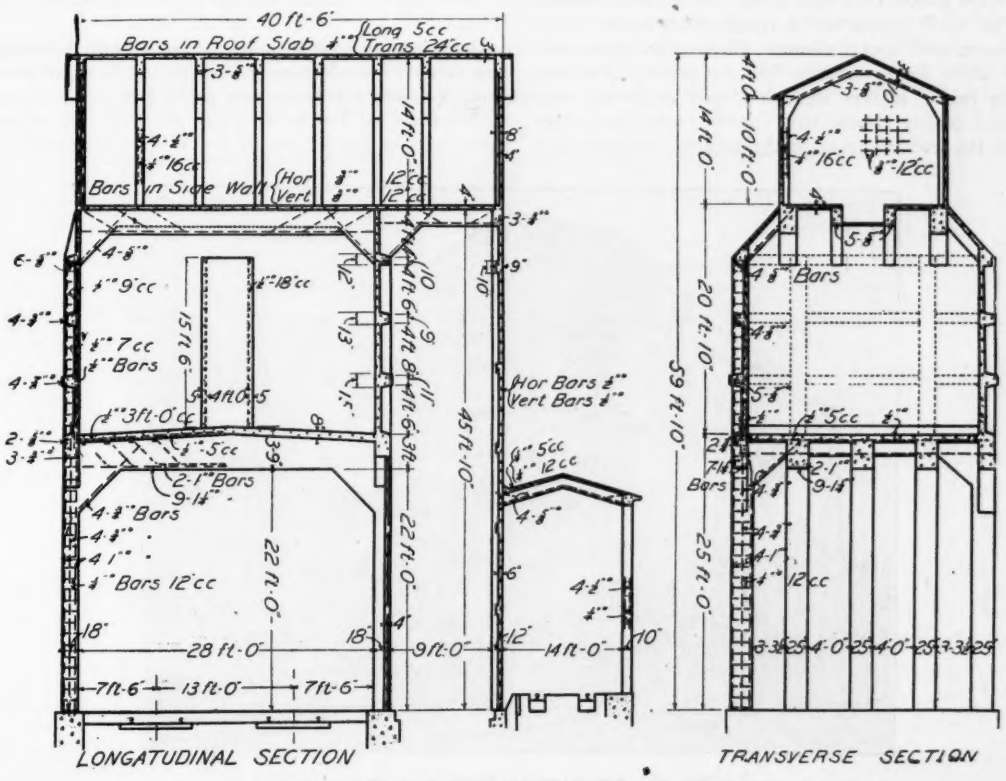


Fig. 29. Longitudinal and Transverse Sections, Sand and Coal Station at Concord.

These platforms are designed by the engineering force of the N. Y. C. & H. R. R. R. under the supervision of Mr. George A. Harwood, Chief Engineer of Electric Zone Improvements.

CHAPTER VIII.

Coal and Sand Stations and Ash Handling Plants.

Reinforced concrete is peculiarly adapted to the construction of structures which are to be used for the storage of coal on account of its undoubtable fire-resisting qualities, permanence and strength.

Through the use of inferior bins such as have been constructed of timber or steel, the railroads of this country have suffered much inconvenience and heavy expense. The spontaneous combustion to which coal is subject when stored in great quantities not only results in the loss of the coal itself and the damaging of much valuable machinery, but also in the destruction of the bin, if it is constructed of either wood or steel.

This condition has led to entirely reinforced concrete structures, even though the initial cost is higher than for wood or

steel. The coal and sand stations which have thus far been constructed of reinforced concrete have given entire satisfaction.

Concord Coal and Sand Station, N. & W. Ry. This combination coaling and sand station, shown by the photograph in Fig. 27, was built and entirely equipped for the Norfolk and Western Railway by the Link Belt Co. of Philadelphia during the summer of 1907. The reinforced concrete details were designed and worked out by Mr. Walter Loring Webb, Consulting Engineer, of Philadelphia, and the concrete work was sublet to McLaughlin Brothers, of Baltimore, Md.

In general the station consists of an elevated coal pocket having a capacity of 260 tons of coal, and a wet sand storage house on the ground with an elevated dry sand bin. The coal is brought to the pocket on a side track, and dumped through a 10 by 12 foot track hopper into a reciprocating feeder which delivers it into a steel bucket elevator discharging into a conveyor trough above for distribution into the pocket. The coal is fed to the engine tenders through hinged gates and over counterweighted coaling chutes, two directly under the pocket and two over the track in front of the pocket. The wet sand passes into a dryer emptying into a sand pit underneath, where it is scooped up and carried by a sand elevator which dumps it from above into the dry sand bin. From this bin it is fed to the engines through two telescopic sand spouts.

In designing the structural features of the station, the unit compression in the concrete was taken as 500 pounds per square inch, and the tension in the steel as 16,000 pounds per square inch. The side walls were designed on the basis of the computed lateral pressure exerted by bituminous coal weighing 47 pounds per cubic foot. This gave a maximum lateral pressure of 248 pounds at the bottom of the pocket, and a vertical pressure on the bottom slab of nearly 1,000 pounds per square foot. The essential features of design and construction are shown very clearly by the longitudinal and transverse sections in Fig. 29.

In the construction of the building, concrete mixed in the proportion of 1 part Portland cement to 2 parts sand to 4 parts broken stone, was used throughout and was mixed in a cubic mixer equipped with hoisting engine and elevator and delivered over the work in batch carriers. The cost of the concrete work was $8,600.

Ash Handling Plants.

Inasmuch as wood burns and steel corrodes, it has long been a problem as to how to build ash handling plants capable of withstanding the destructive effects of ashes quenched with water. The advent of reinforced concrete into the field of railroad construction has successfully solved this problem. At the present time most of the plants being built throughout the country consist of a steel framework which support bins constructed of reinforced concrete. The photograph in Fig. 30 is a good example of such a plant designed and erected in 1905 by the Link Belt Company for the Norfolk & Western Railway at Bluefield, W. Va.

The ash bin has a storage capacity of 30 tons. Ashes are dumped from the engine into 1-ton tubes which rest on trucks in the dump pit below, with their tops flush with the rails, and are raised, dumped into the bin and returned automatically by an electric hoist. In the photograph one of the skips is seen in action.

The ashes are emptied from the bin through a discharge gate into cars on a track directly beneath. The cost of the concrete work including the forms was about $700.

Hoboken Coal Trestle, D., L. & W. R. R. As shown by the photograph in Fig. 31, this trestle forms an approach by which loaded coal cars may be taken to the level of the second floor of the power house where the coal is dumped to the space in front of the boilers. It will be seen that the trestle proper, which is 226 feet 3 inches long, comprising 18 bents on piers spaced 12 feet on centers, has for an inner abutment the wall of the power house and for the outer abutment the end of an approach 112 feet 4 inches long. From out to out the trestle is 16 feet wide, about one-half this width being taken up by a walk each side of the track. The footings, which rest on piles, are 4 feet 9 inches wide and 3 feet thick.

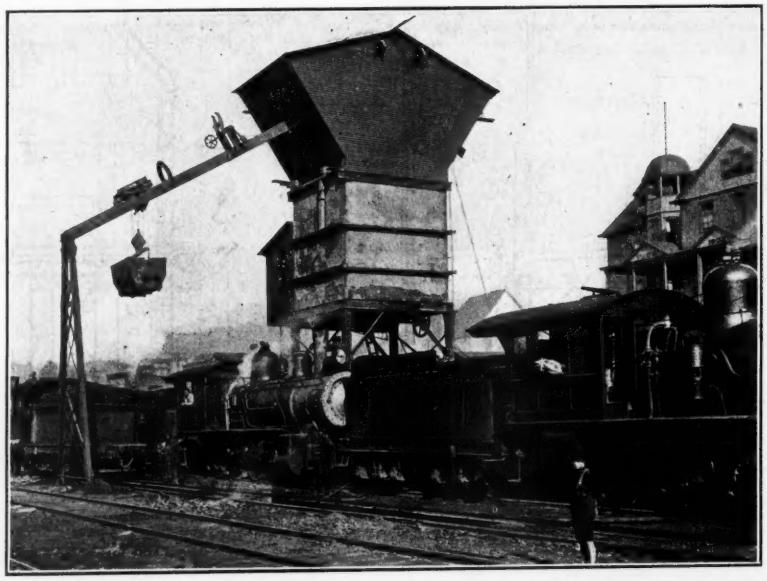


Fig. 30. Ash Handling Plant, N. & W. Ry.

Each pier is 19 feet wide and 18 inchs thick at the top with a batter of 1 inch per foot in cross section of the trestle and ½ inch per foot in longitudinal section, and is reinforced vertically with ¾-inch square bars placed in two rows 3 inches from the outside of the pier, 5 inches on centers underneath the stringers, and 9 inches on centers between the stringers. In addition to these vertical bars, similar ones are placed horizontally 18 inches apart.

The beams or stringers resting on these piers are 18 inches by 27 inches, and are reinforced with three 1¼-inch square bars, two being bent up at the quarter points to take care of the diagonal tension. Over each pier the top of the stringer is also reinforced with four 1½-inch square bars 8 feet 4 inches long.

Every two feet, ¾-inch bolts 12 inches long are embedded 9¼ inches in the top of the stringer to which are secured clamps for holding the rails in place.

The sidewalks are carried by an inverted rail at each bent which extends the width of the trestle. To these rails clips are attached every 6 inches with openings in each leg through which the rods forming the reinforcement of the sidewalk are passed. A mixture of 1:2:4 was used throughout.

The trestle was designed and constructed by the Engineering Department of the Delaware, Lackawanna and Western Railroad in 1907 under the supervision of Mr. Lincoln Bush, Chief Engineer, and Mr. George T. Hand, Assistant Engineer, with Mr. E. I. Cantine as Division Engineer.

CHAPTER IX.

Roundhouses and Turntable Pits

Roundhouses.

The adaptability of concrete to roundhouse construction is clearly demonstrated in the report* submitted on that subject by the Committee on Buildings of the American Railway Engineering and Maintenance of Way Association before the annual convention of that society held in Chicago, March, 1908.

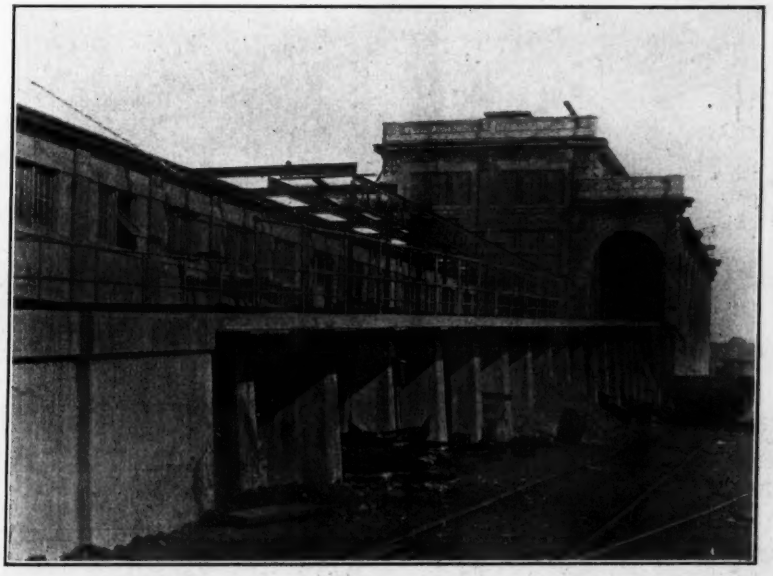


Fig. 31. D., L. & W. R. R. Coal Trestle at Hoboken, N. J.

For the purpose of discussion, the roundhouse was considered divided into Foundations and Pits, Roof, Supporting Columns and Outer Walls; and excerpts from the report are given below in the order named.

Foundations and Pits. "While in some cases local conditions may favor the use of stone or brick for foundations and pits, it may be stated, as a general proposition, that good practice in roundhouse construction now requires the use of concrete for these parts of the structure. When a solid foundation cannot be obtained within a few feet below the floor level of the building a considerable saving may be effected by the use of reinforcement."

Roof. "In economy of first cost, durability and fire-resisting qualities, there is no other fireproof roof construction which is equal to reinforced concrete. Steel except as a reinforcement for concrete is not a satisfactory material for engine house roof construction."

Supporting Columns. "If the roof is of reinforced concrete, it should be supported by columns of the same material in the outer and end walls, as well as in the interior of the building. These columns should be concreted with the roof, the concrete being run into the forms from above. The columns on the inner circle to which the doors are attached should be of some other material than concrete, preferably steel or cast iron."

Outer Walls. "For a structure roofed with reinforced concrete, the curtain walls may be of brick, plain concrete, reinforced concrete or plaster. Concrete will, if properly made, give good service and local costs of materials and labor would ordinarily determine which of the first three styles of curtain walls named above should be built. The plaster curtain wall may be used where it is desirable or necessary to reduce the first cost to a minimum.

"To build such a wall Portland cement is mixed with enough lime so that it can be worked with a trowel and is plastered on expanded metal. The latter is stiffened with rods and channel irons, which are used to support the window frames. A wall of this character can be built more quickly than a concrete wall, is efficient and should be durable. If damaged by a locomotive or otherwise, it is easily repaired, and alterations can be readily made. Used with concrete columns, it should not crack, and its first cost is but about half that of a brick wall."

Cost. "The cost of concrete construction in roundhouses depends largely upon the number of times the forms can be used. It follows, therefore, that where the structure is large and the forms for each unit or stall can be used many times in the same roundhouse, the cost per stall is much less than in a small building. Consequently reinforced concrete construction is more economical in large than in small roundhouses, when compared with brick or frame construction."

It is evident that the concrete house is in the long run more economical, because of its greater permanency and the lesser chance of damage to it and the equipment it contains, by fire and other causes.

Waterbury Roundhouse, N. Y., N. H. & H. R. R. While this roundhouse as designed includes 22 stalls, the part constructed at the present time consists of 10 stalls, each comprising about 8 degrees of the circle, and is connected at one end to a machine shop. The house consists of four circumferential rows of hooped concrete columns carrying beams and roof slabs of reinforced concrete.

The entrance is closed in by large round slat rolling doors between the columns, while the outer circle is encompassed by a

*Proceedings of the Ninth Annual Convention, Vol. 9, p. 166.

brick wall with large glass windows with concrete sills directly in line with the tracks.

Each stall is equipped with an asbestos lumber smoke-jack and each pit is provided with steam pipes for removing ice and snow from the locomotives.

Permanent compressed air jacks are installed in the drop pit under the tracks of two of the longitudinal pits to remove trucks which can then be slid into a transverse pit and thence into the machine shop.

The columns are of square section 14 by 14 inches and are reinforced with six ⅝-inch plain square bars hooped with ⅝-inch round hooping ½-inch pitch.

The method employed in constructing the roof presents a rather unique and interesting feature. While the main girders were cast in place in the usual manner, intermediate beams and roof slabs were moulded on the ground, cured and hoisted to their required position and grouted in place. The intermediate beams, set in reinforced bracketed pockets on the main girder to which they are rigidly connected, were locked by extending the reinforcement from both beam and pocket and filling the joints with wet concrete. The photograph in Fig. 33 of the roundhouse during erection, shows this form of construction very clearly.

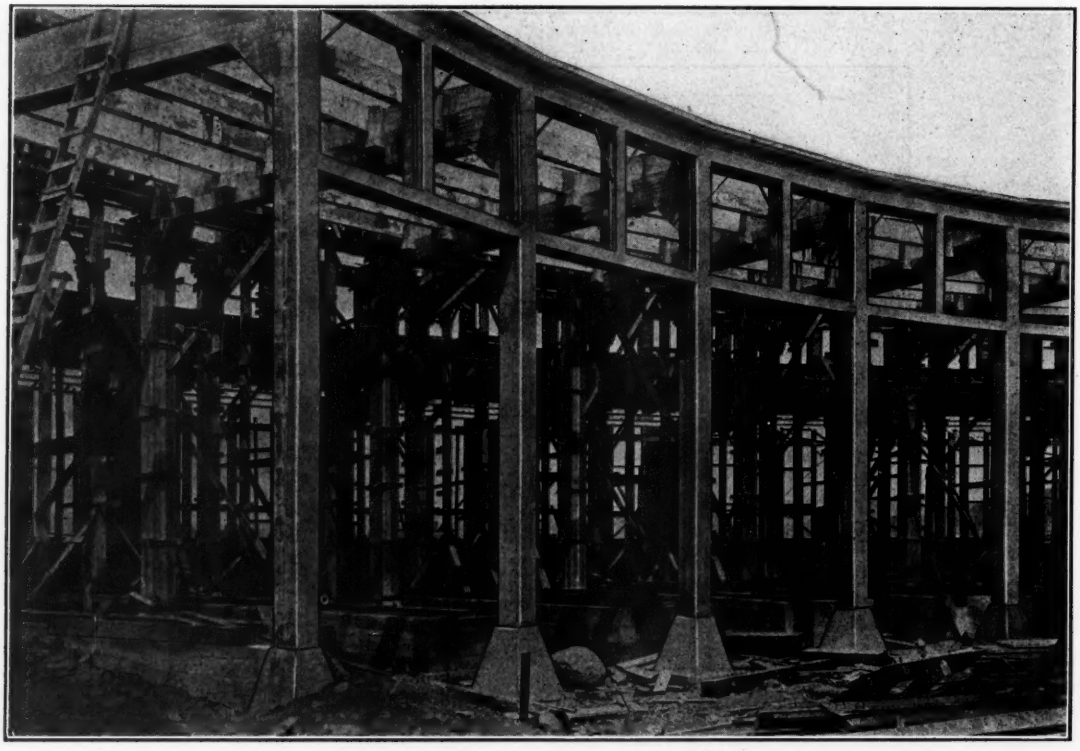


Fig. 33. Waterbury Roundhouse Under Construction.

The roof slabs which are made in widths of about four feet rest directly on top of the intermediate beams and main girders. These slabs are 3 inches thick and are reinforced with woven wire mesh fabric. After the slabs were set, the roof was covered with pitch and slag. A mixture of 1:2:4 concrete was used throughout in the construction of the roundhouse.

The roundhouse was designed by the engineering department of the New York, New Haven and Hartford Railroad, Mr. Edwin Gagel, Chief Engineer, under the direction of Mr. E. H. McHenry, Vice-President, and was built in 1909 by the O'Brien Construction Company of Waterbury.

Turnable Pits.

In connection with roundhouse construction the subject of turntable pits is of special interest. The facility and cheapness with which concrete pits can be built is so generally recognized that practically all turntable pits constructed today are built of concrete. The photograph Fig. 35 is of a standard turntable pit on the Santa Fe System.

(To be continued.)

TIMBER PRESERVATION.

By C. P. Winslow, U. S. Forest Products Laboratory, Madison, Wis.*

The annual cut of timber at the present time is estimated to be in excess of 23,000,000,000 cu. ft., which would make a block of wood a square mile in base and over 800 ft. high. This is three or four times greater than the annual growth of timber in the forest, so that there has been a steady advance in the price of lumber during the past few years. In 1900 the average price of all lumber at the mill was $11.13 and in 1908 $15.37, an increase of 38 per cent. Average cost of all ties at point of purchase in 1906 was 47 cents and in 1909 49 cents.

It is estimated that about 85 per cent of the annual destruction of ties is due to decay and the balance to rail wear and abrasion.

Referring to the growing interest in timber preservation, in 1904 there were 30 timber-treating plants in operation, while at the present there are 82, an increase of 170 per cent in seven years. The material treated in 1907 was approximately 68,000,000 cu. ft. and in 1910 over 99,000,000 cu. ft., an increase of over 45 per cent in three years. In 1909 over 22,000,000

*From a paper given before the Illinois Electric Railways Association.

treated ties were consumed, and of this number 835,000 were used by electric roads; of the total number consumed by the steam roads, approximately 20 per cent were treated, while for the electric roads the consumption of treated ties amounted only to about 10 per cent. Fifteen of the large steam roads now have their own treating plants and many others purchase treated material.

Decay of timber is due to low forms of plant life or fungi, which eat the fibres of the wood. These fungi require for their development requisite amounts of air, moisture and food, and thrive only in a limited range of temperature. If any one of these factors be completely eliminated the timber will not decay, but will last for many years.

The first step in preserving timber and preventing decay is to remove the bark and the second is to thoroughly season the timber so that it can be more readily treated. Ties undergoing the seasoning process should be piled so as to allow a free circulation of air around each tie.

The main step in the process is the injection of a preservative into the wood. Originally a preservative possessing antiseptic properties was considered essential, but of recent years there has been some development in the use of preservatives which depend for their success upon their waterproofing properties. Timber preservatives may be divided into two classes, oils and salts.

Of the oils, creosote, or the oils heavier than water secured from the distillation of coal tar, is the most important. Creosote from water gas tar is also used, being frequently mixed with coal tar creosote. Crude oil from Bakersfield has been used extensively by the Santa Fe Railroad; the process being to impregnate with as much of the oil as the tie will hold. Ties under this treatment have shown a life of over seven years in the humid districts of the Southwest.

Of the salts, zinc chloride in the form of about a 3 per cent aqueous solution is the most commonly used. The usual treatment is to force in as much solution as the tie will hold with a view to injecting from 1/3 to ½ lb. of the dry salt per cu. ft. of timber. This material has a tendency to leach out, but it has the advantage of being cheap, costing about 4 cents per lb.; then the cost of preservative per cu. ft. of timber is about 2 cents as compared to from 8 cents to 10 cents where a treatment of from 8 lbs. to 10 lbs. of creosote is given.

Methods of applying the preservatives may be classified into brush, open tank and pressure cylinder. Brush treatments are often used where the quantity of material to be treated is insufficient to warrant the expense of installing a plant. Such treatment of poles and posts will probably pay for itself, but long life cannot be expected, as the penetration of the preservative is very slight.

The open tank process is well adapted for the butt treatment of posts and poles with preservatives of the oil class. The general method of treating by this process is to immerse the material in the preservative, which is then heated to a temperature of from 200 degrees to 215 degrees F. This temperature is maintained until the air and moisture contained in the wood has become expanded and partially driven off, when the material is either transferred to a bath of cool preservative or the entire charge is allowed to gradually cool. This results in the contraction of the expanded air and moisture and the formation of a partial vacuum, which assists in securing the desired absorption and penetration.

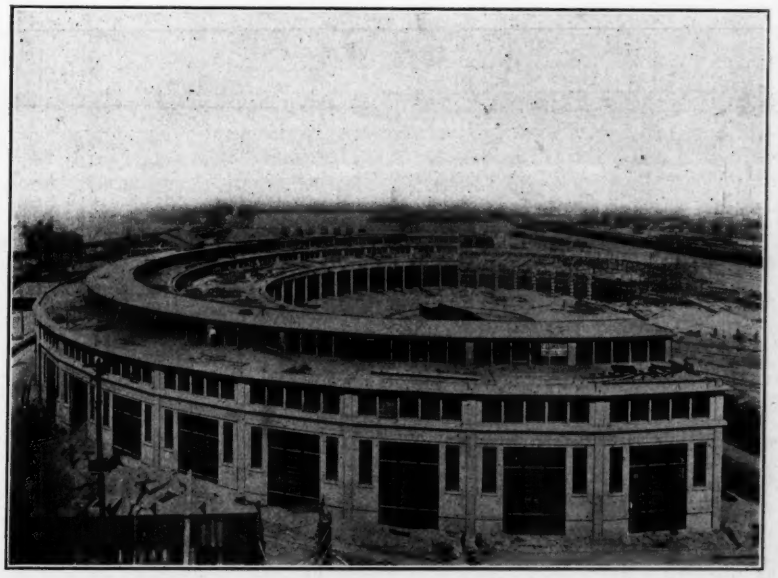


Fig. 34. San Bernardino Roundhouse, A., T. & S. F. Ry.

With the pressure cylinder method, the oil is forced into the timber under pressure. Modern plants of this type consist of horizontal steel cylinders, 6 to 7 ft. in diameter and varying in length up to 130 ft. They are frequently built to withstand internal pressures up to 200 lbs. per sq. in. The material is loaded on small trucks which are run into the cylinder and the preservative is then injected under pressure. A small plant of this type installed by a traction company in Indiana has a 45-ft. cylinder, 6 ft. in diameter, with a capacity of approximately 85,000 ties per year. The complete plant cost about $7,000, although no charge for the land is included in this figure.

A plant recently installed in Alabama with a 65-ft. cylinder, 6 ft. in diameter, designed for 100 lbs. pressure and having a capacity of 140,000 ties per year, cost approximately $12,000, exclusive of the land.

Referring to some known results with treated material; in Europe treated pine ties with tie plates have shown a life of 30 years. Near New Orleans, which has a very damp climate, treated timber installed in 1878 still is in good condition, where-

as untreated timber in the same locality decays in three or four years. A creosoted trestle in this district installed in 1882 was in perfect condition up to 1906, when it was washed out.

At least 10 years is the anticipated life of ties treated by the zinc chloride process by several roads now using this process. Recently the writer examined some 3,000 tamarack and hemlock ties, some untreated and others treated with various processes. Out of 2,700 treated ties installed in 1907, there was but one that showed signs of decay, while out of 300 untreated ties placed at the same time and unprotected with tie plates, from 12 to 14 per cent were ready to remove by reason of decay; from 40 to 60 per cent were rail cut to a depth from ¼ to ½ in. and from 10 to 30 per cent were affected by decay, although not to such an extent as to make them unserviceable at the present time.

The American Railway Engineering Association estimates the life of a properly creosoted tie protected with plates at from 15½ to 19 years, and zinc treated ties at from 10 to 14 years. A number of poles treated in 1902 with the butt treatment were inspected in 1910. The method of inspection was to remove the earth at the ground line, take the measurement, then cut away the decay and take another measurement. Pine poles impregnated with creosote showed practically no decay. Chestnut poles, the butts of which had been charred, showed a loss in circumference of ¾ in., while untreated chestnut poles set in crushed stone showed a loss in circumference of approximately 1¾ ins. Other untreated chestnut poles set in ordinary soil had lost nearly 2 ins. in circumference, while similar poles set in sand had lost nearly 2¼ ins.

Chestnut poles, butt treated in the open tank with creosote, were installed near Buffalo in 1905. When inspected in the summer of 1910 only one pole out of 186 showed decay. Of similar poles, brush treated with two coats of creosote, 17 per cent were more or less affected with decay, but the average loss in circumference for all was only .004 in. All of the untreated poles set at the same time showed signs of decay, the average loss in circumference from this cause being about 1 in.

The American Telephone & Telegraph Company has had very satsifactory results from the plan of placing a creosoted stub beside a decayed pole and securing the two together by means of bolts and wire.

As an example of the economy of treating ties, we will take the red oak tie as a basis. Assume that the first cost of a red oak tie is 50 cents; the cost of creosote treatment about 32 cents; allow 15 cents for installation in case of replacement and 10 cents for installation in new construction. Assume the life of the creosoted tie as 16 years, as against five years for the untreated. At the end of 20 years the actual expenditure, including replacements and interest at 5 per cent, would amount to approximately $12,000 per mile for untreated ties and $8,000 per mile for the treated, or a saving of nearly $4,000 per mile in 20 years. On the basis of annual charges with interest compounded annually, it would be necessary to set aside 15 cents per year per tie to maintain the track with untreated ties as compared to 9 cents for creosoted ties. This is equivalent to an annual saving of about $168 per mile, which on a 100-mile road would be sufficient to pay a 5 per cent dividend on a capital of approximately $336,000. To get the full value of treated timber the tie should be protected against rail and mechanical wear by the use of tie plates and screw spikes. Such a combination could be installed at an additional cost of about 40 cents per tie.

A white cedar pole can be given an open tank creosote butt treatment for about $1.25. Allowing $10 for the cost in place of an untreated 35-ft. cedar pole and assuming a life of 14 years, then a life of only between 15 and 16 years for the treated pole would be sufficient to render its use an economy.

The Forest Products Laboratory at Madison, Wis., is a

Fig. 35. Turntable Pit, A., T. & S. F. Ry.

branch of the Forest Service of the United States Department of Agriculture, although the building itself is owned by the University of Wisconsin. The government now has about 40 engineers engaged in various classes of investigation. The aim is not only to study timber preservation, but to investigate other problems relating to the utilization of forest products. The laboratory includes, together with other equipment, machines for testing the strength of timber, photographic appliances for studying the microscopic structure of different kinds of timber, and a complete laboraotry for investigating problems pertaining to the preservation of timber from decay. The laboratory is desirous of keeping in touch with consumers of timber and of studying peculiar conditions and disseminating knowledge obtained from such investigations.

There are several so-called "combination treatments." With one frequently used the tie is first treated with zinc chloride and is then allowed to season for a time, until the excess water has evaporated. The tie is then subjected to a creosote treatment with a view to forming a plug near the surface of the tie which will reduce to a minimum the leaching of the zinc chloride after the placement of the tie in the track.

The Wellhouse process, formerly quite common, provided for an injection of glue and tannin after the zinc chloride treatment. Material so treated gave satisfactory service in many cases, but the process has practically been abandoned on account of the expense of the double injection.

In the Card process now used by some railroads, from 80 to 85 per cent of zinc chloride solution is mixed with from 15 to 20 per cent of creosote, the mixtures being kept in the form of an emulsion by means of a centrifugal pump, the suction of which is connected to the top and the discharge to the bottom of the treating retort. The C., B. & Q. R. R. uses this process at its plant at Galesburg, Ill.

Within the last year or so one of the Chicago elevated railways found it necessary to renew ties and rail guards on the elevated structure erected 17 years ago. Up to a few years ago the car motors were lubricated with grease and the surplus dripped on the inner guard timbers. It was noted that these inner guard timbers are all in perfect condition and probably good for 30 years, while much of the outer guard is decayed, indicating that the grease is an excellent preservative.

SAFETY FIRST ORGANIZATION, C. & N. W. RY.*

We know that the year ending June 30, 1910, was peculiarly disastrous to those engaged in railroad work. Not only was this true on the North-Western but on all the railroads of the country; and because of this, and because every hour of every day of the 365 days in the year some one was killed on the railroads of this country (35 per cent of them were railroad men); because every five minutes some one was injured on the rail roads of this country, and 80 per cent of them were our people —our fathers, brothers, relatives and friends; because every time a man was killed or injured it meant sorrow, suffering, misery, and frequently destitution to the widows and orphans left behind; because every time one of us was killed or injured it increased the risk to every one left in the service, as a green man had to be put in the place of the man killed or injured, and at the same time the efficiency of the organization went down, frequently seriously crippling it; because of these things the management of the North-Western decided to start this movement for greater safety, in order to make this railroad not only the best, but the safest, to work and travel on.

We commenced the work last summer by holding meetings of the division officers and men, for the purpose of explaining to them the real conditions, the fearful and unnecessary waste of human life, and to get their co-operation and assistance in bringing about a chance to reduce the fatalities and injuries.

After holding these meetings on all seventeen divisions of the system, Safety Committees composed of the men and officers were appointed on each operative division in all the shops, roundhouses, yards and larger stations, to bring about greater safety. These committees meet once a month, the company paying for their time. The members wear a Safety button similar to the design on the banner, to designate their office and authority, and by their appointment a channel has been provided through which not only the members of the committees, but all other employes, can present in a proper and orderly manner suggestions and recommendations for greater safety and improvements in conditions and methods. The management not only invites such suggestions but solicits them, and thereby is afforded the benefit of ideas and observations of the men who are actually doing the work, and given an opportunity to bring the men and officers closer together. From these committees I believe the future officers of the company largely will be recruited.

When discovering defective conditions, customs or careless practices local to their division or plant, these committees are expected to see that the necessary improvement or remedy is brought about. When, however, the matter is of general interest to the system, the same is referred to the Central Safety Committee, meeting at Chicago monthly, at which time suggestions and recommendations are given consideration and adopted when they seem to be practicable.

The result of this movement has been marvelously gratifying to the men and to the management. Last month the personal injuries on the system showed a decrease of 42 per cent—that is, instead of having 909 cases, as we did in March, 1910, we had 529—and what is more remarkable is that in the hazardous occupations, such as of trainmen and switchmen, the decrease was over 55 per cent. During the first nineteen days of April, 1910, we had 603 cases reported, whereas during the first fifteen days in April, 1911, we had 278, a decrease of 325, or 53 per cent.

That in less than ten months we have had on this road fifty-six fewer deaths and 1,493 fewer injuries than we had during the same period a year ago, and at the same time we have carried more passengers and hauled more loads; whereas, during these same months of the previous year we showed an increase over the same period of the year before of 2,318 cases, or 35 per cent. My friends, this not only means that our records contain that many fewer reports of accidents, but that that many fewer times have we been obliged to call the priest and the undertaker; that that many fewer times have we been obliged to call the doctor; that so many fewer times have there been widows and orphans made, and that so many fewer times has some man been obliged to suffer pain and sometimes go through life a cripple. It also means that this movement for the Conservation of Men is getting stronger and better and more lasting every day, and with the same enthusiastic co-operation and assistance of the men of the Safety Committees, and of the other men on this road, we are going to practically wipe out this accident business, because we have commenced to think and act and work along the lines of safety and have demonstrated what can be done when we do that, instead of thinking, as heretofore, that these accidents were unavoidable and a necessary evil.

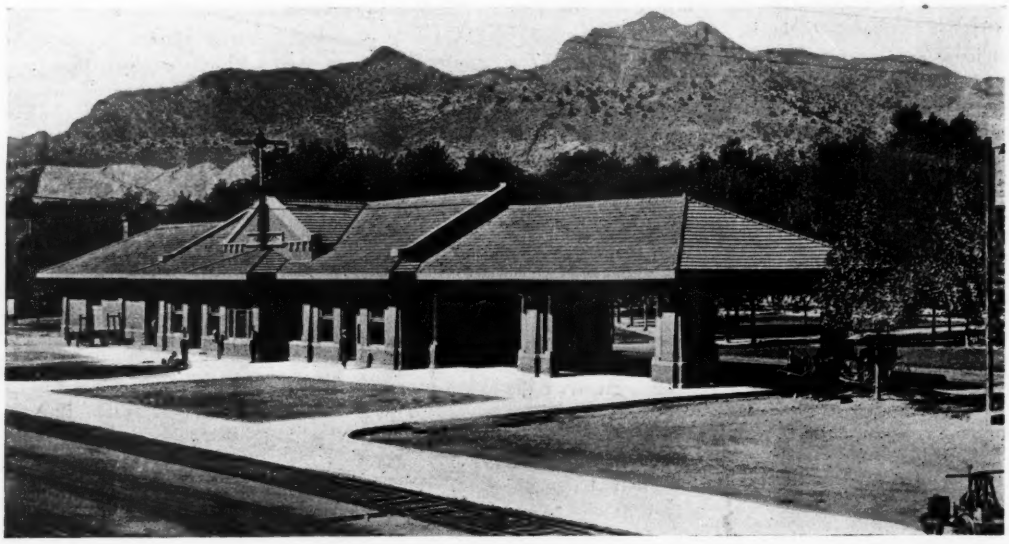
What it will mean to the working man of this country when the management and men on other railroads and industries adopt some similar plan for the prevention of accidents, we can only guess; but if the reports published by the Labor Bureau of the United States are correct and the total annual fatalities and injuries in the work-a-day world in this country, as shown in that report as 35,000 deaths and 350,000 injuries, are correct, you can realize as well as I what it will mean to the working

*Extracts from an address by R. C. Richards in presenting "Safety First" banner to Sioux City Division.

men and their families, as well as to the industries, to reduce that fearful toll one-half.

If in ten short months we men on the North-Western can bring that about, why cannot others do the same if they go about it in the right way?

The credit for the success of the movement belongs to the men, as they are the ones who have done the work and demonstrated what 464 pairs of eyes and as many active minds—there are that many members of the Safety Committees—can do in the way of discovering defective conditions and improper methods, and in preventing accidents. Without the co-operation and enthusiastic assistance of the members of the Safety Committees, as well as that of other employes, the movement would have been a failure; with such co-operation it is necessarily a success, and, like every great movement in the annals of the world, it is a triumph for enthusiasm.



Canon City Passenger Station, D. & R. G. Ry.

CANON CITY STATION, DENVER & RIO GRANDE RY.

The stations and terminals recently constructed by railways show that increasing attention is being given to architectural details. The Denver & Rio Grande Ry. station at Canon City, Colo., is no exception to this rule, although not a large station. It is an example of a convenient and comfortable arrangement, combined with a pleasing architectural exterior. The photograph shown was taken just after the station was completed.

The station building was designed by Mr. E. M. Camp, an architect of Chicago, who was formerly engineer of bridges and buildings for the company. The foundations of the structure are of concrete. The walls were constructed of a hard burned semi-vitrified brick made by a local brick manufacturer of Canon City. This brick is rather dark and slightly mottled in texture and affords a most admirable building material for public structures. Bedford stone for trimmings was used throughout the construction, while the roof is laid with red tile of the Niagara pattern. The floors, including the floor under the pavilion, but excepting that of the office, are concrete. The office floor was constructed of quartered Texas pine. The interior woodwork is also quartered Texas pine, stained and varnished. The building is very admirably lighted by electricity, especial attention having been given to the illumination by the electrical engineer of the Denver & Rio Grande. An efficient steam heating system is provided, such systm being self-contained within the structure.

There is nothing very unusual or very interesting about the track layout at the station. There are three tracks, the two main double tracks and one depot track, all situated in front of the station. Several new tracks were laid through the lower yard. A subway was put in at South Ninth Street at a cost of about $25,000. The plans for this subway were gotten out by the Railway, and were submitted to the city officials for approval.

The station is one story high, but has a basement in which are the boilers and accessories of the steam heating plant.

The station, which presents a very artistic appearance from the town side, is situated in a small park, owned by the railroad company, but maintained by the city. The structure with its platforms covers the length of a whole city block, and because of the wide expanse of lawns and platforms between the main track and the building proper, and with the park for a back ground, it affords to the traveler a most pleasing view from the car window.

HARDWOOD TIES ON THE PANAMA R. R.

About 8,000 hardwood ties have been received by the Panama Railroad Company to date, for use on the permanent line. These ties are purchased in Colombia, and are shipped via the Royal Mail Steam Packet Company's vessels from the ports of Savanilla and Barranquilla. The majority of the ties are hewn from guaiacum, or lignum vitae, but three other classes of hardwood are accepted, namely, polvillo, corteza, and balsamo. On account of the hardness of the wood, the ties have to be bored for the spike. A special tie-boring and planing machine is used, which adzes two parallel faces to form the seat for the tie plate, and bores a hole to receive the spike. A patent tie plate and screw spike are used. This equipment greatly lessens the liability of rails spreading. A good many of the softwood ties on the permanent track between Panama and Corozal have been replaced with hardwood, and the same equipment has been extended to other sections of the permanent, or relocated line, where 90-lb. rails are being laid.

THE NEW C. & N. W. RY. TERMINAL AT CHICAGO.

Running Story of Construction.

By W. C. Armstrong, Terminal Engineer.

On the first of November, 1906, I began my duties as terminal engineer in charge of the construction of the new passenger terminal in Chicago. The work of preparing maps, collecting data, and making preliminary designs had been going on for about a year, and the general features of the scheme had been pretty well determined. The site of the station building had been chosen; the location and extent of the station yard had been fixed; the location of the approaches with the number of tracks needed had been decided, and a general outline of the scope of the work had been made public only a few weeks before.

I had not been connected in any way with the early studies of the plans and my only knowledge of these plans was that gained from the published accounts in the daily papers when the information was given to the public. My first duty, then, was to learn what I was expected to do.

An interview with the chief engineer, Mr. Carter, gave me a general idea of the work to be done and the extent of my duties in respect to this work. I was given a copy of the maps which had been prepared covering the territory involved in the project and copies of such preliminary plans as had been made up to that time, and was instructed to take up the work at that point, develop the further studies that were necessary in connection with track arrangement, retaining walls, street viaducts, station yard, trainshed and all the various facilities to be provided.

Following this interview I walked out over the site of our proposed operations, and it was only then that I began to comprehend the real magnitude of the undertaking.

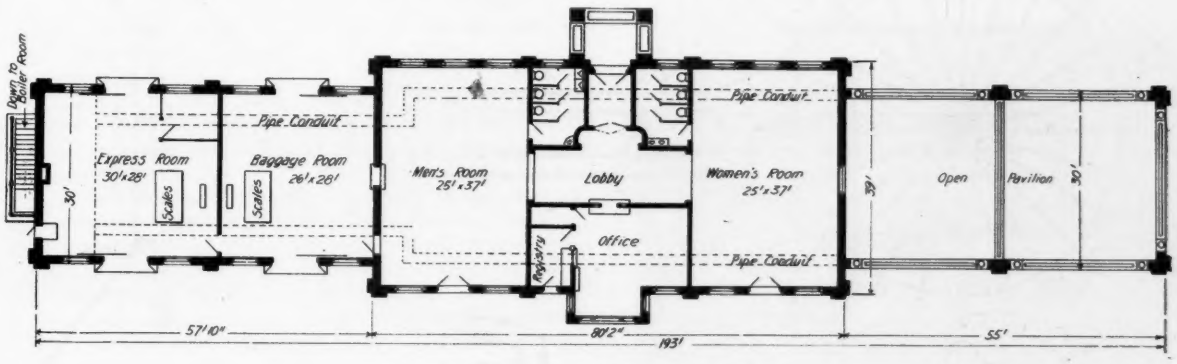
From Madison street to Milwaukee avenue, between Canal and Clinton streets, now within the enclosing walls of the station proper, were solid rows of brick buildings from one to six stories in height. Many of them were historic buildings, identified with the early history of Chicago. At the corner of Madison and Clinton streets stood the old Gault House, a famous hostelry in the early 70's. At the corner of Madison and Canal streets was the Grand Central Hotel. It had perhaps been aptly named but its "grandeur" had long since passed away. Along Canal and Clinton streets were numerous machinery companies and concerns dealing in iron and steel and heavy hardware. The Ryerson iron and steel warehouse occupied the site of the present power house.

North of Fulton street was a large four-story brick building occupied by the Miehle Printing Press Company, and between Carroll avenue and Kinzie street was a large newly built brick structure five stories high owned by the Tyler Hippach Plate Glass Company.

Over the north and west approaches were numerous larger factory buildings, tenement houses and residences. All of these buildings had to be removed before construction operations could be begun. In all there were 455 buildings to be removed. Sixty-six of them were four stories or more in height.

On Lake street the Chicago & Oak Park Elevated structure was an obstruction to the tracks into the terminal, which in some way had to be removed. The entire terminal territory was covered with a network of telegraph, telephone and electric light wires which had to be disposed of and rearranged. In the streets were sewers, water pipes, gas pipes and electric conduits which would interfere with street viaduct foundations and necessitate a change in their locations. The clearing of the right-of-way, and removal of the various obstructions both overhead and underground was in itself not a very simple matter.

Some knotty problems in design and construction were presented. In Carroll avenue and just south of it, the P., C. C. & St. L. Ry. tracks were to be crossed. In addition to their two main line tracks were four freight house tracks, a freight house and teamway. Our tracks had to be carried overhead and all their freight-handling facilities had to be maintained. This required that the freight house be rebuilt



Floor Plan, Canon City Station, D. & R. G. Ry.

under our structure, that the teamway and house tracks be preserved, and that our structure be of such permanent, solid and waterproof nature as to form a perfect roof over all these facilities.

At Kinzie street and between Kinzie and Jefferson streets the terminal structure would have to be carried over a perfect network of Northwestern surface tracks. This was the junction of the Galena and Wisconsin division surface tracks and the tracks of the Grand avenue coach yard.

On the north approach the terminal structures in many cases had to be designed to cross over the intersection of two streets, which added greatly to the complication. At the extreme west end of the west approach, where the terminal tracks connect with the Galena division tracks, another complicated structure was to be worked out.

But the most serious difficulty to be faced was the fact that all the construction operations had to be carried on in a territory of congested traffic. Hundreds of carloads of materials would have to be brought into the terminal territory and distributed to the various working crews. To get this material in without delaying regular trains and without delay to the workmen appeared to be a very serious problem as viewed from the outset of the work. Had the scene of operation been a few miles outside of the city limits, the difficulties would have been reduced by fully one-half.

A force of draftsmen was organized and work was started

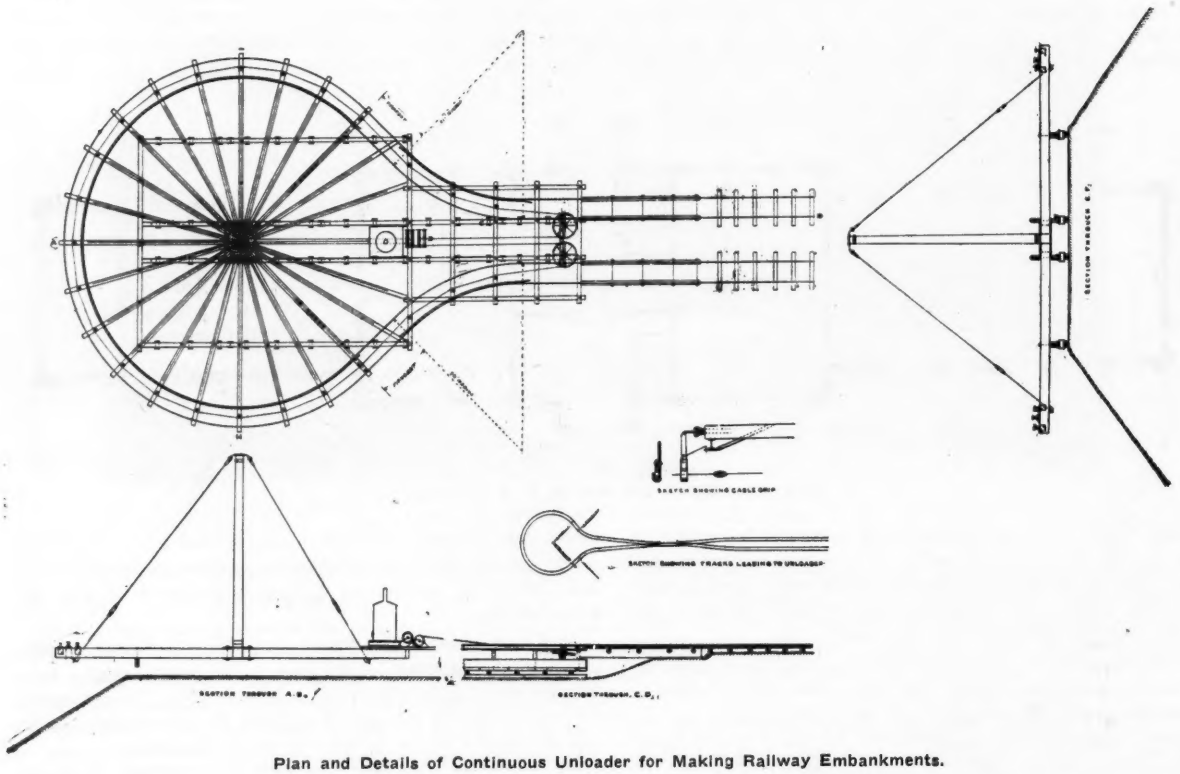
on preliminary plans of the various structures and track arrangements. Numerous plans were drawn tentatively, studied, discussed and discarded, their meritorious features, if they had any, being embodied in more acceptable plans which were afterwards drawn and again subjected to consideration and discussion. By this process of elimination the final plans were agreed upon, but not in many cases until the plans had been redrawn many times over. This was particularly true of the track and switch layouts, station yard tracks and platforms, trainshed, and some of the special steel structures. The entire year of 1907 and a considerable part of the year 1908 was devoted to the preparation of plans, although the final plans for many of the structures were completed and ready for construction long before they were all finished.

While the work on plans was in progress, the work of wrecking and removing buildings and clearing the right of way ready for construction was also going on. As soon as the right-of-way negotiations for any piece of property were concluded and we obtained possession, the buildings were sold to the highest bidder on the condition that he remove them completely in the shortest practicable time. In nearly all cases the buildings were wrecked, although some of them were removed bodily to other sites. A notable example of the moving of a building was that of the five-story brick block owned by the Tyler Hippach Plate Glass Company. The railway company purchased this building and had it moved a distance of 220 feet. The moving was successfully accomplished, without a single crack in the walls or even the loosening of a brick. Another instance of successful moving was an apartment house on Austin avenue. It was cut in two parts, and each part moved separately a distance of over a quarter of a mile, where they were again put together into one structure.

As I have previously stated, the Chicago and Oak Park Elevated structure in Lake street formed an obstruction to our tracks entering the new station yard. It was too high to pass our tracks overhead, and too low to pass them underneath. It could not be lowered, for that would obstruct traffic on the street. It only remained to raise their tracks higher, and to substitute some other type of construction in place of the numerous column supports which would have been an obstruction to the large number of tracks and switches we had planned to have at that point.

To obviate the entire difficulty, the original elevated structure was removed completely for a distance of 155 feet and a truss span substituted at a higher level, making room underneath this span for all the tracks entering the station yard.

As the tracks on this span were about five feet higher than they were on the original structure, it was, of course, necessary to raise the tracks at either end of the span to meet the increased height, by an easy incline in each direction. This was done by jacking up the elevated structure and lengthening the columns supporting it by splicing to them short sections of varying lengths corresponding to the amount the grade was to be raised. This change in the grade of the elevated road covered a distance of about 2,000 feet, extending from Union street to the Chicago river. It was the first piece of actual construction work done on the terminal, and was begun in June, 1908.



Plan and Details of Continuous Unloader for Making Railway Embankments.

The work of building retaining walls, abutments, and foundations for street viaducts on the new terminal approaches was commenced in September, 1908. Fortunately the winter of 1908-9 was very mild and the work of mixing and placing concrete in these walls was carried on almost continuously during the winter months; so that the spring of 1909 found us with a large proportion of the foundation and retaining wall work on the west approach and the terminal proper finished.

But the year 1909 was the period of greatest activity. Work of all kinds was being pushed as rapidly as materials

could be assembled and men could put them in place. Pile drivers were in operation over all sections of the work. Gangs of men were excavating for the foundations of various structures. Carpenters were busy building concrete forms. Concreting outfits were mixing and pouring concrete into the finished forms. Structural steel erection crews were assembling the steel work for street viaducts and for the track structure and trainshed in the station yard. Trainloads of sand were being unloaded for embankments where the retaining walls had been finished. Track gangs were laying tracks and switches where the banks were completed. Various other work was in progress, such as laying drain pipe, waterproofing viaduct floors, building electric conduits, paving streets and laying cement sidewalks.

In many instances, work was in progress night and day, the crews working in three shifts of eight hours each. During the busiest portion of the season there was an average of 2,500 men at work, including labor of all classes. In the engineering department about fifty men were employed, including draftsmen and the other office employes, assistant engineers, instrumentmen, rodmen and inspectors.

By the close of the year 1909, most of the concrete retaining wall work had been finished. There was still a large amount of steel work to be completed, particularly in the track floor and trainshed in the station yard. There also remained considerable sand filling to be completed. Only a small proportion of the permanent track had been laid, and very few permanent switches had been placed.

Practically all of the electric conduits were yet to be built, and the signal and interlocking work had not yet been started. The vast areas of track floor on steel work in the station yard were yet to be covered with concrete and waterproofing.

It is true that great progress was made in the year 1909. But it was the work that made a good showing—the larger things that appealed to the eye of the casual observer. We were now coming to the more intricate and tedious details—the "finishing touches" so-called. A few weeks' work on a large retaining wall was quickly noted by the passer-by, while the same amount of work on an underground conduit would fail to attract his attention.

Some idea of the extent of the work may be gained from the following statement of

Areas, Dimensions, Etc.

Station building, 320 ft. by 218 ft.	69,760 sq. ft.
Station yard, 320 ft. by 1,072 ft.	343,040 sq. ft.
Trainshed roof	265,800 sq. ft.
Right-of-way acquired	37 acres
Ground area of buildings wrecked	20 acres
Number of tracks in station yard	16
Total length of yard tracks	14,330 ft.
Total capacity of yard tracks	200 cars
Number of tracks in station approach	6
Number of passenger platforms	8
Width of platforms	16 ft. 9 ins.
Aggregate length of platforms	7,160 ft.
Number of streets bridged	40
Number of alleys bridged	13

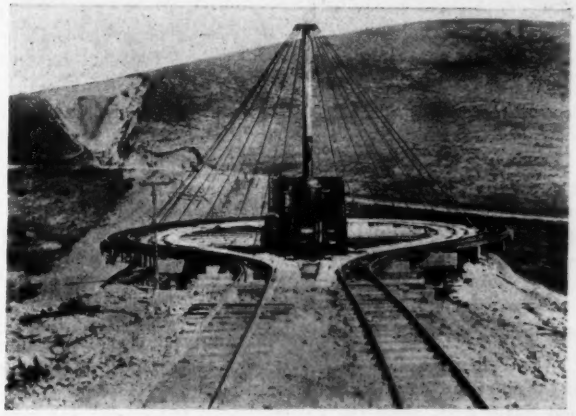
The magnitude of the construction operations are fairly represented in the following statement of

Quantities of Work.

Excavation for foundation	250,000 cu. yds.
Piles driven, 43,000	1,530,000 lin. ft.
Concrete	275,000 cu. yds.
Structural steel	37,000 tons
Waterproofing	665,000 sq. ft.
Conduit pipe	220,000 lin. ft.
Curbing	23,000 lin. ft.
Cement sidewalk	240,000 sq. ft.
Paving	50,000 sq. yds.
Tracks	18 miles
Single switches	82
Lap switches	4
Double slip switches	39
Crossings	6

An array of figures usually produce little impression on the average reader. They are lacking in that vividness necessary to fix and hold his attention. The popular magazine writer would have presented these in a way to cause the reader to "sit up and take notice." He would have given the various areas in square inches. He would have called attention to the fact that the cement used in concrete would have filled a train of box cars twenty miles long; that the gravel and sand for same would have filled a train of gondolas seventy miles long; that the piling driven in foundations would have built forty miles of pile trestle; and if all the piles had been laid out end to end they would have made a line 290 miles long, and would have reached from Chicago to Marshalltown. But an engineer's story of an engineering project should contain no such illuminated statement. His professional dignity forbids.

It must therefore be left for the reader to form his conception of the magnitude of the work from the cold figures above presented. If he has had personal experience in such work he may be able to read between the lines and thus more fully realize what expenditure of mental and physical energy and what burdens of responsibility these figures represent.—*The Northwestern.*



Continuous Unloader.

DEVICE FOR BUILDING RAILWAY EMBANKMENTS.

By F. F. Lloyd, Patentee, Berkeley, Cal.

In making two of the highest fills on the Western Pacific R. R. at Altamont, Cal., a new device was used. The method did not require temporary trestles which would have been very high and expensive, nor was there any delay such as is often occasioned by an incompleted trestle. One fill was 125 ft. high, and 750 ft. long. The other was 114 ft. high, and 1,200 ft. long.

The continuous unloader, illustrated herewith, consists of a circular track resting on radials, and partially supported by rods, suspended from a mast, in the center of the structure. The entire frame rests on rollers, under which are short stringers, and the device is moved ahead by its own power, ten or fifteen feet at a time as the work progresses.

On the unloader is placed a double drum hoisting engine, which operates a cable that leads around the circular track, between the rails, and is held in place by cast rollers. A train of eight, ten or twelve loaded cars is pushed by a locomotive to the unloader, where the cars are picked up by the cable and hauled around. Three or four-yard side dumping cars, 36-inch gage, are used. As the cars are unloaded while in motion, one man with a dumping stick can dump them as fast as they come to him. Two men knock the chains loose, and two men pull them back and chain up. One engineer, one gripman, and two block men complete the force required to operate the unloader.

While the loaded cars are going around the circle, the engine switches from the delivery, to the receiving track and is ready for the empties. The empty cars having been delivered to the engine, the ball on the cable is pulled back, and is ready for another train.

On Western Pacific work, trains of cars were handled faster than a 65-ton steam shovel, side cutting, in good material, could load them, and the dirt loaded by two steam shovels can easily be handled. The maximum time consumed in moving the machine forward is 90 minutes, and this work is usually done during a meal hour, so as not to delay the steam shovel. Where the material in the fill does not settle very rapidly the move is made in about 30 minutes.

Continuous Unloader Making a High Fill on the Western Pacific Ry.

The accompanying illustrations were obtained while the unloader was in use on the Western Pacific R. R. and show the general features of the device, while the plan gives the construction in detail. The construction is such the parts are easily separated for shipment on an ordinary flat car.

RECLAMATION OF TIDE LANDS.*

By J. O. Wright, Supervising Drainage Engineer.

During the past three or four years there has been a rapid and continuous increase of interest in the reclamation of the tide marsh lands along the Atlantic coast, and enough has been done to encourage the belief that it will be possible under proper methods to reclaim a great portion of this now almost worthless land and make it valuable for agricultural purposes. All the lands along the coast which are covered or practically covered with salt water at high tide are classed as salt marsh. They extend from the eastern point of Maine to the peninsula of Florida, being broken in places and with irregular boundaries, and vary in width from a few hundred feet to several miles.

Character of Soil.

The soil of these marshes is composed of sediment or silt, mingled with the remains of animal and vegetable life. There is a variety of opinions as to the fertility of this soil, but the chemical analyses of numerous samples, together with the crops produced where tracts have been reclaimed, show that they are extremely productive, and with proper treatment, including the leaching out of the excess of salt, can be made a valuable addition to our agricultural possessions. The soil varies in depth from a few inches to ten or fifteen feet, and usually rests on a bed of sand or clay. In some places, however, the vegetable matter so predominates that the soil is so light that when saturated with water it has a tendency to float. Such lands are called "floating marshes." They are difficult to reclaim, and are not so valuable as others for agriculture, but even these when drained become more firm and make good pasture and meadow. The value of these marshes depends largly upon their elevation above sea level. Large tracts below sea level have been reclaimed by means of costly dikes and expensive machinery for pumping the water, as in the Netherlands, but land always submerged is not strictly tide marsh, and will not be considered in this discussion.

The fluctuation of the tide along the coast varies from two to eleven feet, the average being about four feet. Where the fluctuation is above this average, drainage without resort to pumping is usually feasible. Dikes serve to keep out the sea at high tide and automatic gates permit the escape of the water through the dikes at low tide.

Inducements for Reclaiming.

While the country adjacent to these tide lands was sparsely settled and there was plenty of high land for cultivation, there was neither incentive nor necessity for reclaiming them, but during the last decade these conditions have radically changed. The Eastern portion of the United States has become densely populated. Numerous towns and cities have grown up along the coast, creating a great demand for the products of the farm and garden. To make room for this rapidly increasing population and provide a suitable place possessing proper sanitary conditions for residences, and to satisfy the demands for fruit, vegetables, and dairy products, it is necessary to reclaim some of these marsh lands.

Within the last ten years the scientists of the country have proved conclusively that certain species of the mosquito are the most common, if not the only, means of disseminating the germs of malaria and introducing them into the human system. In places where the mosquito has been exterminated malarial diseases have greatly decreased or entirely disappeared. It is a well-established fact that the tide marshes are a serious menace to the ehalth of the people in their vicinity and a great hindrance to the settlement and development of the country in that locality. They breed mosquitos by the million, which destroy the comfort and enjoyment of the people and greatly annoy the domestic animals.

These waste places, rich in fertility and having an ample supply of moisture for plant growth, only need draining to enable heat and air to penetrate the ground to make them ideal locations for truck gardening on a large scale. Many of these are so situated as to offer economy in transportation which furnishes another important reason for their early reclamation. Either by rail or boat products can be landed cheaply and quickly in the market places of large cities or thriving towns at very little cost. This adds greatly to the commercial value of the land and allows for a much more liberal expenditure for its reclamation than could be borne if there had to be added to the cost of production the cost of a long-distance haul to market.

The desire to reclaim these marshes is evidenced by the many attempts that have been made to do so. That some skill and knowledge in this work are required is also shown by numerous failures. Works to keep out the sea on one side and prevent rains and storm water on the other from flooding or injuring crops, must be wisely planned and carefully executed. Nothing is so insidious in its attacks as water; and the dikes and drains which form a part of reclamation work on tide marshes have to contend with burrowing animals, with a foundation at first extremely unstable, and must anticipate the changes which will be brought about by the drying of the land on one side and withstanding the attacks of the sea on the other. If the plans are inadequate or the work poorly done, failure will surely follow.

These difficulties are understood now better than formerly and the owners of these lands or the communities interested in their reclamation are seeking to avail themselves of all the experience and information both in engineering and agricul-

*From a Bulletin of the U. S. Department of Agriculture

ture which can be gathered, and they are making many inquiries of the Department of Agriculture as to how particular projects should be carried out, how dikes and ditches should be planned and built, and the land be made ready for the planting of crops. Some of these inquiries are for information and advice about the organization of communities for the carrying out of large projects; others have to do with methods for removing the water and the subsequent treatment of small areas. As these lands, taken together, have an aggregate productive area equal to that of agricultural states like Illinois or Missouri, it follows that their successful reclamation and cultivation means an important addition to the national wealth. Many of the attempts to carry out these works have been delayed or have been prevented for the time by a lack of information and lack of confidence on the part of the land owners directly interested. These land owners are unwilling to sanction the improvement or contribute to its expense until they can be assured through some authoritative or disinterested source that the reclamation of tide marshes is feasible; that the land when drained will be productive; and that this drainage will not interfere with other industries such as the fisheries along the seacoast bordering the marsh lands. They wish to have some knowledge regarding the kind of dikes needed for protection from the sea and the kind of drains and pumps needed to put the land in proper condition for cultivation after the inflowing tides have been cut off.

Some of the Results of Drainage.

About the only agricultural product grown on these lands in their native condition is marsh hay. This hay sells at present in the vicinity of Boston at $8 a ton. On areas which have been drained the hay sells for $25 a ton, and the yield per acre is larger than on the undrained tracts. The simplest form of improvement possible, therefore, increases the productive value of these lands threefold, but the greater part of the lands which have been reclaimed are too valuable for the growing of hay, and have been brought immediately into intensive cultivation. Cranberries are probably the most important crop at present grown on tide marshes. The area of cranberry bogs is being constantly extended and the trade in this fruit has assumed large proportions. Cranberry growing during the past two or three years has been quite profitable, and this has resulted in a marked activity in the extension of the area devoted to the crop and to the value of the lands reclaimed. Good bogs along the North Atlantic coast now sell for $1,000 an acre and pay a large return on this investment. The need of these marshes for truck farming is more apparent now than formerly because of the great increase in the number and population of some seaside resorts. Along Cape Cod and much of the Massachusetts coast the uplands have not the fertility needed for successful gardening. Much better results can be had from these marshes when drained than from the higher lands. In many places the growing of fresh vegetables in the immediate vicinity of town, requires the reclamation of marshes, and they are proving well adapted to this use. Asparagus grows with unusual vigor in such soil, and in places near Boston excellent crops are being produced where the marshes are occasionally flooded with sea water. Celery does excellently in some localities, but has failed, for reasons not well understood, in others. Cauliflower, cabbage, onions, muskmelons and watermelons, cucumbers, lettuce, sweet corn, field corn, potatoes, oats, redtop, timothy, and alsike clover are all crops being successfully grown on reclaimed marsh lands along the North Atlantic coast; onions, celery, asparagus, cucumbers and melons being the most profitable crops.

For many years the tide marshes of the South Atlantic coast were largely devoted to rice growing, and this is still the most important use of these areas, but changes in the flow of the rivers, which have taken place as the result of the removal of the forests and from other causes not so well understood, are bringing about a change in these lands, under which they are being more and more converted into truck farms. Asparagus, peas, potatoes, lettuce, beans and cabbage are being raised in large quantities and shipped to the northern markets for sale early in the season. The products are of good quality, the business is proving profitable, and the area is being continually extended. There are, however, as yet many unsettled questions connected with this kind of agriculture.

The benefits of drainage to railroad companies would be of two kinds: First, the actual benefit to the right of way through making a more stable roadbed and in reducing the cost of maintenance; and, second, by increasing the business of the road through the development of the district. The first-mentioned benefit is probably the only one for which the railroads may legally be assessed, but the latter is by far the more important, and in view of this fact the railroads can well afford to adopt a liberal policy of encouragement.

Drainage in European Countries.

The most notable example of the reclamation of salt marshes is furnished by the Netherlands. Here the work has been carried on for centuries, during which a large part of Holland has been wrested from the sea. Lands no more fertile than the marshes of this country now suppport a population of 450 to the square mile, while the density of population in New Jersey is but 250 and that of New York 153. These figures show the possibilities of salt marshes in the climate of the North Atlantic States. Equally encouraging evidence of the value of the marsh lands of the South Atlantic seaboard is furnished by the results of draining the low lands of Italy along the Adriatic Sea. This work was begun in a systematic way in 1882. Before that time the cost of constructing efficient drainage works was beyond the unaided financial resources of individuals or communities. Agricultural progress was practically at a standstill; the health of the population was menaced by malarial conditions and depopulation of some districts was threatened. Foreseeing this danger the Italian Government, after a thorough, detailed study, passed a comprehensive drainage law providing for the organization of districts and for financial aid from the General Government and from the provinces. As a result of this work many thousand acres of land have been reclaimed and are now growing high-priced crops. Land values have been largely increased, and some of the drained districts now have a population of between 400 and 500 to the square mile.

(To be Continued.)

FURNACE SLAGS IN CONCRETE.

There is produced annually in the United States over ten million tons of blast furnace slag, which up to a recent period, has been considered a worthless or waste product. Attempts have been made to use this slag in various ways, such as casting the molten material in moulds to form bricks or slabs for street pavement, in crushing and screening the slag after cooling to prepare ballast for railroads, in using the properly sized material for the building of macadam roads, and when granulated, as a base for the manufacture of Portland cement. These attempts have met with considerable success, but they consume only a portion of the slag produced, leaving large quantities available for other uses as substitutes for stone and kindred materials.

Almost any hard substance, that has strength and will not disintegrate makes a good aggregate in concrete. The kinds of materials ordinarily used for this purpose range from broken granite or other rock to broken brick and ashes. Following are the results of a series of tests of blast furnace slag in various forms, used as an aggregate in concrete.

The aggregate performs a very important function, and the strength of the concrete depends very largely on the shape, character and strength of the aggregate. The use of concrete as a substitute for stone, brick and iron has shown a very rapid increase within the last decade. Any material which will improve the quality of the concrete without materially adding to its cost, must command the attention of the user. It was believed from the results of some preliminary tests on blast furnace slag used in concrete, that the important properties exhib-

ited by this material would be of great value to the concrete engineer.

Materials Used.

Cement. Universal Portland, specially tested for uniformity.

Sands. (*a*) Slag Sand No. 1, made at Carrie Furnaces at Homestead Steel Works Plant, by an improved method briefly described as follows: The molten slag is delivered from the furnace through the ordinary trough or runner to a concrete pit, at the edge of which the trough takes the form of a large nozzle, fitted with an annular ring, from which issues water in the form of spray delivered through a four inch pipe under pressure of from thirty to forty pounds per square inch. This

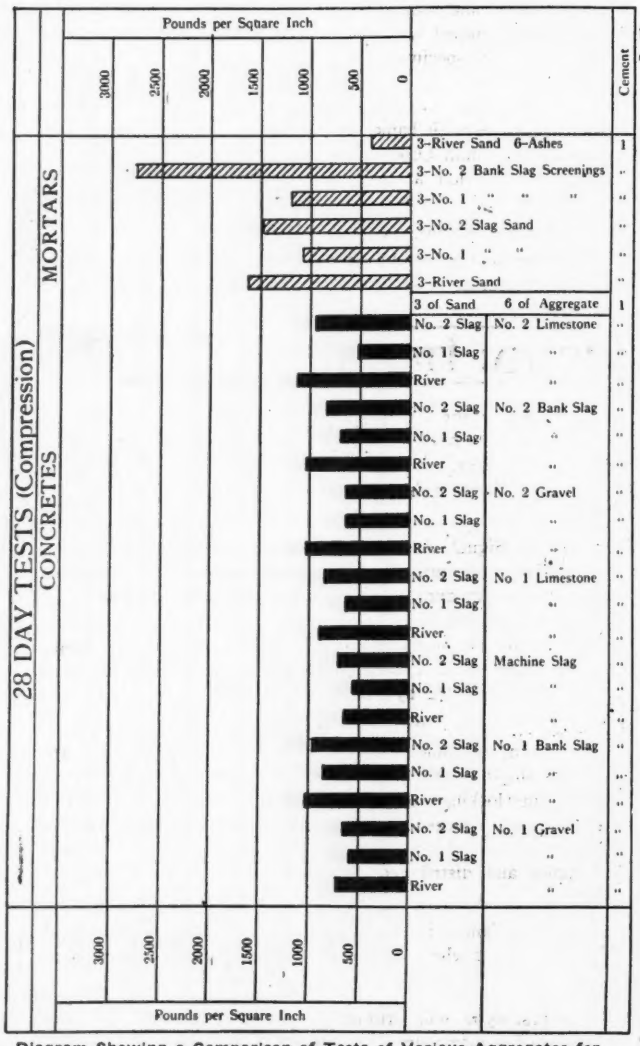

Pounds per Square Inch
3000
2500
2000
1500
1000
500
0
Cement
28 DAY TESTS (Compression)
CONCRETES
MORTARS
3-River Sand 6-Ashes 1
3-No. 2 Bank Slag Screenings "
3-No. 1 " " " "
3-No. 2 Slag Sand "
3-No. 1 " " "
3-River Sand "
3 of Sand 6 of Aggregate 1
No. 2 Slag No. 2 Limestone "
No. 1 Slag " "
River " "
No. 2 Slag No. 2 Bank Slag "
No. 1 Slag " "
River " "
No. 2 Slag No. 2 Gravel "
No. 1 Slag " "
River " "
No. 2 Slag No 1 Limestone "
No. 1 Slag " "
River " "
No. 2 Slag Machine Slag "
No. 1 Slag " "
River " "
No. 2 Slag No. 1 Bank Slag "
No. 1 Slag " "
River " "
No. 2 Slag No. 1 Gravel "
No. 1 Slag " "
River "
Pounds per Square Inch

Diagram Showing a Comparison of Tests of Various Aggregates for Concrete.

causes disintegration and partial cooling of the slag, which operations are further accomplished by the water with which the pit is partly filled, and by the force of the impact with which the slag is thus driven against the opposite wall of the pit. In appearance slag thus granulated resembles that described below as Slag Sand No. 2, except that the largest particles are much smaller and the entire product is somewhat more dense. It is removed and loaded into cars by the usual grab bucket and crane.

(*b*) Slag Sand No. 2. Common granulated slag as made at many blast furnace plants, by running the molten slag directly into a tank or brick or concrete pit partly filled with water, in which the disintegration of the slag is accomplished by simple contact with the water. This product contains many light fluffy particles in addition to those of finer and denser character and much of it is as coarse as popped corn, which, when the color is light enough, it rather resembles. Owing to its great porosity much of it floats until it becomes cold and saturated with water, and only the denser particles settle at once to the bottom of the tank. It is widely graded from fine to coarse.

(*c*) River Sand. A natural product dredged from the rivers in the Pittsburg district. That from the Allegheny was selected for these experiments as being freer from coal which frequently occurs in considerable percentage in sand taken from either the Monongahela or Ohio.

(*d*) Bank Slag Screenings No. 1. The fine screenings from the slag crusher plant of the Duquesne Slag Products Company, containing no particles larger than $\frac{3}{16}$ inch.

(*e*) Bank Slag Screenings No. 2. The screenings from the same plant as above, containing particles ranging from dust up to ½ inch in size.

AVERAGE WEIGHTS OF CONCRETES

1 Cement	3 Sand	6 Aggregate	Average Weight Per Cubic Foot	Average Weight Per Cubic Yard
	River	No. 1 Gravel	141	3807
	No. 1 Slag Sand	" "	134	3618
	" 2 " "	" "	138	3726
	River	No. 1 Bank Slag	138	3726
	No. 1 Slag Sand	" " "	121	3267
	" 2 " "	" " "	131	3537
	River	Machine Slag	129	3483
	No. 1 Slag Sand	" "	120	3240
	" 2 " "	" "	122	3294
	River	No. 1 Limestone	142	3834
	No. 1 Slag Sand	" "	136	3672
	" 2 " "	" "	140	3780
	River	No. 2 Gravel	144	3888
	No. 1 Slag Sand	" "	135	3645
	" 2 " "	" "	136	3672
	River	No. 2 Bank Slag	137	3699
	No. 1 Slag Sand	" " "	129	3483
	" 2 " "	" " "	128	3456
	River	No. 2 Limestone	146	3942
	No. 1 Slag Sand	" "	139	3753
	" 2 " "	" "	143	3861
1	3	Mortars		
	River		127	3429
	No. 1 Slag Sand		100	2700
	" 2 " "		103	2781
	No. 1 Bank Slag Screenings		130	3510
	" 2 " "		134	3618
	River Ashes		91	2457

RELATION OF VOLUME OF CONCRETE TO VOLUME OF AGGREGATE

Proportions	Cement Cubic Feet	Sand Cubic Feet	Aggregate Cubic Feet	Actual Volume
1, 2, 4	6.75	13.5	27	30.3
1 2½ 5	5.40	13.5	27	29.0
1, 3, 6	4.50	13.5	27	28.1

APPROXIMATE WEIGHTS OF SLAGS

No. 1 Slag Sand	1900	pounds to	2000 pounds.
" 2 " "	1450	" "	1600 "
" 1 Furnace Slag	2000	" "	2100 "
" 2 " "			
Machine Slag	2100	" "	2200 "
No. 1 Slag Screenings	2400	" "	2500 "
" 2 " "			

NOTE.—The above are average weights, which will vary somewhat depending upon moisture.

Aggregates. (*a*) Bank Slag No. 1, the crushed and screened product of the Duquesne Slag Products Co., ranging in size from ½ to 1 inch.

This material, as also the two grades of screenings above described and the Bank Slag No. 2 next below, is air cooled blast furnace slag, excavated from the waste banks where, months before, the molten slag had been poured and allowed to accumulate and gradually cool. The excavated slag is crushed and screened to graded sizes.

(*b*) Bank Slag No. 2. Same as No. 1, except that the largest size pieces are 2½ inches.

(*c*) Machine Slag, sometimes called Pancake Slag, which is made by running molten slag from the blast furnace onto an

endless chain conveyor furnished with suitable shallow cast iron pans. The length of the conveyor, about one hundred fifty feet, is sufficient when the rate of travel is approximately seventy feet per minute, to allow the slag to cool and set—water is sprinkled on the slag just before reaching the dumping point at the end of the run, for further cooling and cracking the thin sheets of slag, and the drop into the car breaks them into small pieces, ranging in size up to about 1 inch. If the machine is run at a speed much greater than that mentioned, or if water is applied too soon, the product reaches the car in a semi-molten condition or containing a considerable percentage of granulated slag greatly impairing its value.

(*d*) Gravel No. 1. The commercial product dredged from the rivers in and near Pittsburg, sized from 1 inch down to and including a small percentage of sand.

(*e*) Gravel No. 2. Same as No. 1, except that the range of size of pebbles was from 2½ inches down.

(*f*) Limestone No. 1, from Martinsburg, W. Va. Crushed to sizes from 1 inch down.

(*g*) Limestone No. 2. Same as No. 1, except that sizes were from 2½ inches down.

(*h*) Ashes. Ordinary boiler ashes or cinders, introduced into the experiment because of their somewhat extensive use in making a light concrete for fireproofing purposes.

Mixtures.

Upon examination of all the materials it was found that the commonly employed proportions, of 1 part cement to 3 parts sand and 6 parts aggregate fairly represented the demands of theory, and it was decided to adopt arbitrarily this proportioning throughout the entire series of experiments. The specimens were moulded in sheet steel cylindrical forms and were 12 inches in diameter, by 16 inches in height.

Care was taken to handle and treat all materials and specimens uniformly and at the same time as nearly as possible as they would be in average practice. The specimens were properly marked, dated and stored under cover until ready for testing. They were sprinkled with water daily for the first 27 days. A total of twenty specimens of each combination or mix were made, and at least three were subjected to compression test at each age interval. With the exception of a few two year old specimens made with bank slag screenings, all tests were made on a 400,000 pound Olsen machine at Homestead Steel Works, under the direction and supervision of the same men. The exceptions noted were tested at the U. S. Government Testing Laboratory on a 600,000 pound Olsen machine.

The average test results of three specimens of each mix at each age interval are shown in the tables and diagrams.

The Signal Department

SIGNAL STANDARDS NO. 20—THE LOUISVILLE & NASHVILLE.

The Louisville & Nashville R. R. first used automatic signals in 1907. Installations have been two position lower quadrant with a stroke of approximately 7½ inches. At present the General Officials are considering making the three position upper quadrant signal the standard. The night color indications are green for clear, yellow for caution, and red for stop. Signals are operated by electric motor with mechanism at either the top or bottom of the posts. The types of battery housings used are concrete well, concrete box, iron chute, concrete chute, and in Southern territory a case at base of signals. Soda batteries are used for operating signals. The same battery is used for line circuits and signal operation. The track battery standard is the gravity, but at some points Columbia Soda is used. Two cells are used in all batteries.

Track circuits are direct current and have an average length of 3,000 feet. Relays are the standards of the Signal Association, and are furnished by a number of manufacturers. The average length of a block is 1 mile, and overlaps are used at some points. No automatic stops are used.

Line wire is No. 10 H. D. D. B. copper or copper clad; there are no separate pole lines for signal circuits. Common return is broken every seven miles, approximately. Above ground wood trunking is used for wire ducts, and below ground fibre conduit in concrete is used. In interlocking towers the wires are in loricated pipe. The following kinds of wire are used: For bootlegs, No. 9 S. B. 5/64-in. Wall insulated; for leads from track, No. 9 S. B. 5/64-in. Wall insulated; lor leads from line, No. 14 S. B. 3/64-in. Wall insulated; in chutes, No. 9 stranded 5/64-in. Wall insulated.

Switch indicators are always used on double track. On single track they are used only occasionally where it is found more economical to place an indicator than to install another signal. Brackets posts are used to same extent.

APPARATUS FOR CHARGING STORAGE BATTERIES.*

H. K. Ferguson, R. E. Russell, E. E. Kimball.

In presenting this paper, it is not the intention of the writers to enter into any discussion of the question of primary vs. storage battery for the operation of signals. The assumption is made at the outset, that this question has been carefully weighed, and that, for some particular situations, and for proper reasons, decision has been made in favor of storage batteries.

Previous Signal Association literature upon the subject of apparatus for storage battery charging seems to be rather limited. In looking over the records, we have been unable to find anything dealing specifically with the question, with the exception of some of the specifications of the Committee on Power Interlocking, and a special paper on Mercury Arc Rectifiers, which was presented by Mr. Corey in 1906.

Storage battery installations may be of two general types—stationary or portable. Stationary batteries may be concentrated at a single location, near the power plant, as in the case of electric interlocking, or they may be distributed at a number of locations, and charged from a transmission line, as in the case of automatic signals. Portable batteries are charged at some one point and distributed for use.

Because of the nature of the battery applications, as outlined, charging appliances for signaling may be divided into two types. First, those for charging a battery at or near a power plant; second, those for charging through a transmission line.

The first type will ordinarily require a mininum of about 2 volts and a maximum of about 175 volts, with a minimum of 5 and a maximum of 40 amperes. The second case will require, for transmission line of average length, from 500 to 600 volts, with any economical charging rate. This may in some instances be surprisingly low, with good results. The usual rate is from 4 to 10 amperes. In order to strike a fair average, we have based the following discussion upon a 5-kilowatt requirement, which is probably rather above than below the usual size.

One of two general conditions will be found to exist with regard to the power possibilities for any battery charging problem. (1) There may be a commercial or other source of direct or alternating current available at suitable voltage, and at an advantageous price. We earnestly recommend and investigation of such possibilities for each situation.

If current can be had as above mentioned, the purchase and operation of an expensive prime mover such as a gasoline or

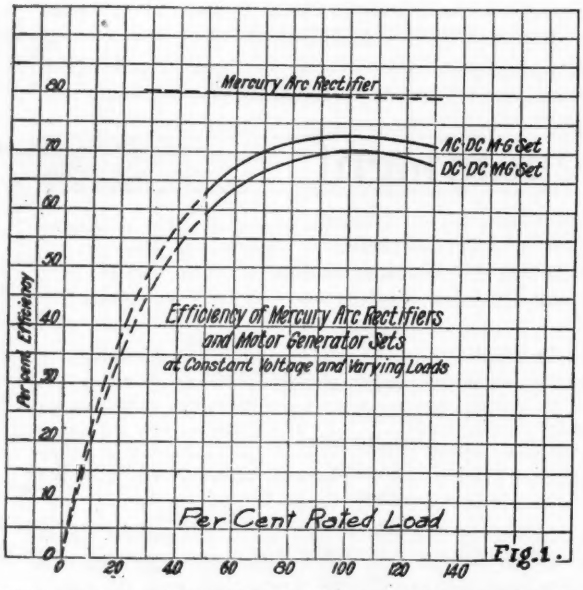
*Extracts of a paper given before Railway Signal Association.

a steam engine, may frequently be omitted entirely with a consequent reduction in initial and operating costs.

(2) There may be no outside power possibilities at all. In this case there is of course no alternative except the installation of a complete power plant for battery charging.

The most desirable and economical condition seems unfortunately, to be the least frequently found in actual practice. This is when direct current can be secured from a reliable source from the railway power house or a commercial circuit at a fair price, and at a practically constant voltage, equal to, or only slightly exceeding the maximum voltage required for battery charging. In cases of this kind regulation between the maximum and minimum potentials required may be readily accomplished by the use of suitable resistances or rheostats. No rotary machines are necessary; a simple switchboard panel for mounting the proper instruments and regulating and protective devices is all that is required.

Any battery charging plant will have to embody one or more of the following types of apparatus:



Efficiency Curves, Mercury Arc Rectifiers and Motor Generator Sets; Constant Voltage, Varying Load.

D.C.-D.C. motor generator set; A.C.-D.C motor generator set; mercury arc rectifier; dynamotor; rotary converter; steam turbine driven unit; steam engine driven unit; gasoline engine driven unit; switchboard panel; battery charging panel.

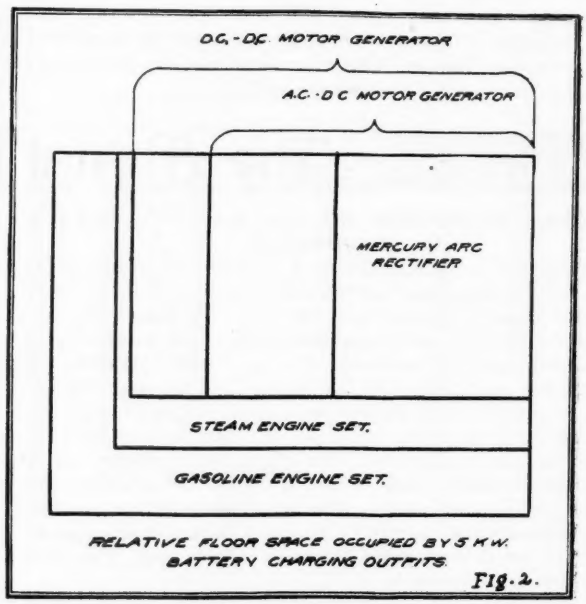
The first five types are converters of electric energy and adapted for battery charging only with an external source of current. Types six and seven may ordinarily be taken to presuppose an existing steam supply, as the installation of individual boiler capacity would be prohibitively expensive. Type eight, the gasoline engine outfit, is the best practical outfit at present where no external source of energy exists. Type nine is accessory to the preceding items with the exception of the mercury arc rectifier, which requires no additional switchboard. Type ten is also accessory, but used only where several sets of duplicate battery at a concentrated location require special controlling devices not convenient for mounting on the power panel.

For various reasons items four, five and six will not prove applicable to many railway signal installations. The dynamotor is a machine with two independent armature windings on the same core each winding having a separate commutator. One field winding only is provided for both armature windings. Difficulties with the voltage regulation and the fact that these machines are more or less special, and consequently rather expensive, have so far prevented their general application to signal battery charging.

The rotary converter, in small sizes, is in but very little demand, and is apt, in consequence, to be rather high in price. Besides this, the impressed alternating current voltage bears a constant ratio to the direct current voltage generated by the rotary converter, so that the direct current voltage can only be changed by regulating the alternating current voltage. The ratio of alternating current to direct current is .6 for three-phase circuits, and .7 for single and two-phase circuits. Because of these reasons, the rotary converter has so far been limited in its field of usefulness for signal purposes.

Steam turbines in small sizes are not ordinarily as efficient or as easily regulated as the small steam engine. They also are not so frequently used and in consequence are more expensive. They will not be found satisfactory for many signal installations.

Having thus limited our field of possibilities to motor generator sets, rectifiers and steam engines, where electric or steam



mains are available, and to the gasoline engine for isolated locations, we will endeavor to compare these possible appliances as to efficiency, first cost and floor space, believing that the reliability of any of them may be depended upon if purchased from a reputable manufacturer.

Fig. No. 1 has been prepared to show the efficiency curves of five kilowatt motor generator sets and a mercury arc rectifier at various loads. The thermal efficiency of the gasoline engine is much higher than the steam engine but this advantage is usually much more than offset by the cost of fuel.

Efficiency is by no means the only thing to be considered in planning a satisfactory charging plant. However, efficiency together with the amount of attendance required are the principal factors in determining operating cost.

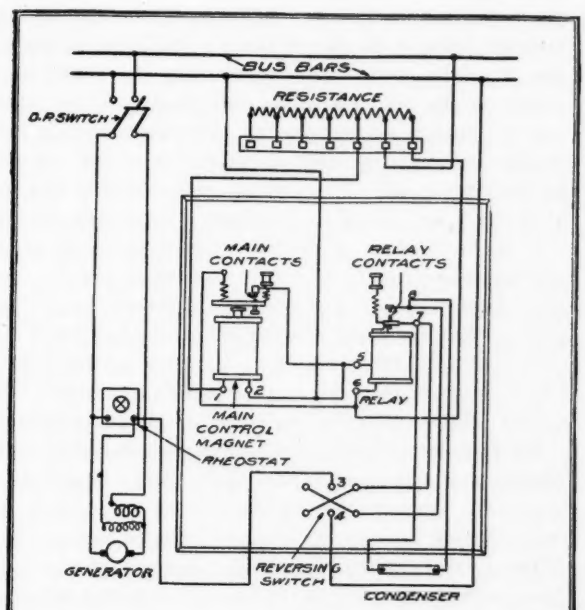
In locations where floor space is limited, the amount of room necessary for any particular type of apparatus is worth considering. Fig. No. 2 shows the space requirements for a five kilowatt outfit.

Comparisons of first cost should be made for each particular situation when two or more possibilities are involved. In general it may be said that the mercury arc rectifier will be least expensive; motor generator sets will be only slightly higher; steam

engine sets rank next, provided boiler capacity is available; and gas engine outfits are most expensive.

Motor generator sets are in common use for signal battery charging. They should be preferably direct connected, because more reliable and requiring less floor space. They are readily adapted for all of the current and voltage requirements for signal work. While constant voltage is desirable for driving the motor, even trolley current fluctuating rather widely may be used, with a proper automatic voltage regulator. Fig. No. 3 has been prepared to show the circuits for such a regulator.

A particularly desirable method of operation may be obtained by using a small motor generator set for continuous operation, with the battery, load, and generator all in multiple. This method, which is ordinarily known as "floating the battery," permits the generator to carry most of the load and charge the battery at a slow rate. When heavy current output is required and the generator voltage is pulled down, the battery helps out the generator by feeding into the circuit in parallel with it. The battery is also available as a reserve to carry the load for some time in case of a failure of the power supply or motor generator set.



CONNECTIONS OF VOLTAGE REGULATOR FOR DIRECT CURRENT GENERATOR

Fig. 3.

The question of duplicate sets of battery and of charging apparatus has been, and is yet, an open question. For installations where the charging set is kept in good condition, is not overloaded, and is of reliable manufacture, it seems hardly probable that a duplicate set is necessary simply for emergency use.

The shunt wound type of generator is best adapted for battery charging because of convenience of voltage regulation, which is essential for any generator for such service.

Alternating current motors for A.C.-D.C. sets should be three-phase if it is possible to obtain three-phase power service. This is due to the fact that a three-phase motor is usually smaller and less expensive, and the small sizes require no starting apparatus. Some phase-splitting starting device is necessary with any single-phase motor.

In sets of odd size, where direct connection would be expensive because of special speeds or sizes, an alternative is presented by the use of a "silent chain drive," which is reliable, requires much less floor space than any possible belt connection, and may sometimes prove economical in first cost without increasing operating expense.

Mercury arc rectifiers, with the improvements made in recent years, are proving to be one of the most valuable devices for battery charging. They are complete in themselves, requiring no apparatus not included within the smallest floor space required for any battery charging outfit. They are made in standard sizes ranging from zero to 175 volts and from 10 to 40 amperes.

This range of voltage limits the rectifier at present to battery charging at concentrated locations and for short transmission lines, as its maximum voltage is not high enough to operate a long series charging line successfully even at a low charging rate.

Ordinarily the rectifier is designed for operation on 60 cycles, at 110 volts or 220 volts, single phase alternating current, but it may readily be adapted for other voltages, or frequencies down to 25 cycles. Recent rectifiers are simple in design and method of operation and are proving reliable in railroad service.

Steam driven units can be obtained in small sizes adapted for steam pressures as low as 80 pounds. These sets are useful wherever steam pressure may be had. They occupy but little floor space and require but little attendance, though rather more than a motor generator set of similar capacity. Steam sets are ordinarily provided with a heavy fly-wheel and closely regulating governor, which results in close speed regulation and practically constant voltage. Consequently, no automatic regulators of any sort are necessary or advisable.

With the present cost of fuel, gasoline engine sets are more expensive in operation than any of the previously mentioned outfits. They occupy the most floor space and require some cooling apparatus beside the engine and generator. With slight modifications they may be operated by either gasoline or gas. They are built with various numbers of cylinders for either two or four cycle operation. When reliably built and of good design, the gasoline engine is undoubtedly the best, however, and practically the only economical prime mover for battery charging service at isolated locations.

Where a number of such outfits are in service, without the installation of duplicate sets for "stand-by" service, an emergency outfit may readily be provided mounted in a car or on skids, complete with cooling tank, etc., for quick shipment to points where it may be required.

In conclusion, we recommend again special investigation into existing power supply conditions at all proposed battery charging locations. In the small quantities required for signal battery charging, current can ordinarily be purchased much more cheaply than it can be generated independently.

An analysis of each situation may show several possibilities. In such cases it will usually be found helpful to tabulate the possibilities of each solution, item by item, in parallel columns. Each item, such as efficiency, attendance, first cost, reliability, and floor space should be given its relative value for the situation in hand.

A consultation with the electrical engineering force of the railroad will ordinarily be found to be a fruitful source of information. Manufacturers are usually willing to make alternative quotations upon the several types of apparatus involved, when first cost is of paramount importance. When requirements and possibilities have been listed and compared, it is usually not a very difficult task to decide which type of apparatus to install for battery charging.

The Maintenance of Way Department

DOUBLE TRACKING.

THE BUILDING OF A second track or "double tracking" is simpler than extending a track over a new line, for the track already laid can be used for distributing the new material. In building a new line, material must be moved over the track which is under construction.

The proper distribution of laborers is dependent on class, size, and weight of material, as well as on the class of labor employed. Individual opinions and methods of foremen also cause differences in distribution of men. After a grade has been completed and the ties lined and spaced approximately, a gang might be organized as follows, subject to the supervision of one foreman and one assistant:

Tie fiddler	1	Spike and bolt peddler	1
Tie spacers	2 or 4	Spikers	12
Steel gang	12	Tie nippers	6
Rail nipper	1	Gage liner	1
Strap hangers	2	Back bolters	2
Strap tighteners	2	Tool man	1
Joint plate peddler	1	Water boy	1

The tie fiddler is provided with a fiddle, i. e., a short board with a cleat nailed on it at right angles near one end. The distance from the inside edge of the cleat to the end of the board is the standard distance for the rail base from the end of the tie. This fiddle is held on the face of the tie with the cleat securely against the end, and a mark made on the tie along the uncleated end of the fiddle. The outside track spike should be set on this line when spiking. Before marking a tie, the fiddler should examine it, and be sure that the bark side is up. The tie fiddler will generally be able to run ahead of the gang without difficulty. He should also set the tie line. For this purpose it is handy to have a board of such a length that if one end is placed against the ball of the rail in the old track, the opposite end will show the proper line for the new track ties.

Behind the tie fiddler are two tie spacers. They are provided with a rod of the same length as the rail which is to be laid. The marks for tie centers for one rail length are marked off on the rod, which is laid on the ground with the rear end even with the head end of the last rail laid. This rod should be used on the line side, as the line rail is set up first. Picks are generally used by the tie spacers in dragging the ties to center. The pick point should be stuck in the end of the tie and never in the top or side of a tie. When spacing ties the man on the line side pulls the ties to the line (previously stretched), and the man on the gauge side places the end of his tie so that it lays square across the grade. The tie spacers must space ties for a full rail length while the steel gang is setting up two rails. Possibly four tie spacers may be needed in some cases in order not to delay the rail gang. The spacers must also inspect all joint ties, and if they are deficient in size or quality, they should be exchanged for those of better grade. In lining ties they should not be pulled up against the tie line, but should be left about ¼-inch away. If the ties are allowed to touch the line, some of them are bound to throw a kink in it. If broken joints are being used in the track, the work of tie spacing is increased. Several ties near the middle of the line rail will have to be shifted in order to fit the joint slots on the gauge rail.

The rail gang picks up the rail, sets the rear end on the ties, at the same time entering the rail ball into the angle bars hung on the rail previously laid. The head end of the rail is dropped at a word from the heeler, and this movement throws the rail into proper position in the anglebars. The heeler now gives the command "heel," and the rail is pulled backward against an expansion shinn, inserted between the ends of the rails. In setting up the line side the assistant foreman should see that the rail is set as near as may be to its correct line, as shown by the fiddled chalk marks on the tie. The gauge rail should also be placed approximately in correct position. For this purpose a light wooden gauge can be used; if none is furnished, one may be easily made with a board and a couple of blocks of wood. If the rails are set up as described, scarcely any lies will have to be lined up by the line spikers; the work of the gauging spikers is also reduced to a minimum, and the track when finished will be approximately in correct line, so that work is saved the lining gang, as well as the spikers.

In order to facilitate setting up a rail and putting it in its proper place in the angle bars, a nipper is provided. He carries a bar to raise the angle bars or rails as necessary.

The strap hangers use short handled wrenches, these being handier and permitting faster work than long handled wrenches. The latter are not necessary as the strappers are only required to start the nuts, and not to tighten them. When a rail is set up, the strapper hangs a pair of angle bars on the head end. As the next rail is heeled into place he puts in a bolt through the rail being placed, and after giving the nut a few rapid turns, goes ahead and repeats the operation. Two bolt tighteners follow, and tighten the nuts which the strappers have started.

The joint plate peddler places the joint plates under the rail in the proper position for spiking. The spike and bolt peddler distributes four spikes for each tie, and enough bolts and nuts locks at each joint to finish bolting in full. These two men should work together and help each other out whenever necessary.

Before spiking a tie, the nipper on the head gang of spikers should see that the outside of the base of rail is nearly in line with the chalk line marks on the ties. If it is not in line, he should move the rail over approximately to line with his nipping bar.

The outside line spiker sets the outside spike on the fiddled mark, and gives it one heavy blow with the spike maul. The nipper then raises the tie up against the rail with a bar, using as a heel the nipping block. This operation shoves the ties over until the line spike sets snugly against the rail. The inside spiker then sets his spike, and both spikes

are driven. The spikers work in six gangs, three on each side of the track. The head gang spikes every third tie, the second gang takes the tie just behind it, and the third gang spikes the remaining tie. The rail, when spiked, should have a solid bearing. If the face of the tie does not afford a good even bearing, the gauge spikers must adze off the part of the tie beneath the rail, so that a good bearing is assured. In having the gangs spike every third tie there are the following advantages: (1) Twelve to 16 spikers may be kept working in a distance of 60 feet or less, and being close together, allow easy supervision by the foreman. In the older meethod—i. e., each gang spiking a rail length in full—the spikers frequently become scattered 200 to 300 feet. Spikes should be driven perpendicular and uniformly on the corresponding edges of the ties and to accomplish this it is necessary to have the men close enough together so that the foreman can easily watch each man; (2) Any gang of spikers must do as much work as the head spikers, or fall behind, since the gangs are spiking tie for tie. It is easy in this manner to discover an unwilling or incompetent man; (3) By putting the best gangs in the lead on each side of the track a greater amount of work is accomplished. The back bolters bolt the joints in full and twist up each nut as tightly as possible. Back bolting requires little skill and only ordinary strength; this is a good place to start in green or inexperienced men.

One of the most important men on the gang is the tool man. If a good trustworthy man is selected he may save the foreman much responsibility. He is held accountable for the number of tools on the work each day, and also for the tools in the tool boxes. The condition and supply of tools can be left entirely with him; in case any are in bad order, it is his business to exchange them for good tools; if necessary he must use his own ingenuity in repairing those on hand or in "borrowing" from other gangs. A live tool man will be on the lookout and know when new tools arrive on the job, and thus be sure of obtaining his share. Although little hard work is required, a tool man should be chosen who is industrious, reliable and intelligent.

A very handy way of taking care of tools and surplus material, in double tracking, is to have a push car on the track which is being built; the tool boxes are kept on this car. The tool man shoves the car along as the work advances; he takes out the shims and picks up all scattered tools and light track material, loading them on the car. In this manner excess tools and materials are convenient for emergencies. The dumpy should be securely locked to the rails each night, using a heavy chain and padlock.

When setting up rail, the assistant foreman has charge only of the steel gang, strappers, tie spacers, and the fiddler. If these men are able to run far ahead of the spikers, setting up rail can be discontinued and the rail gang organized into spikers, bolters, etc. The assistant foreman is responsible for proper expansion in the track and must be careful to use a uniform thickness of shim. If track is laid with square joints, the assistant foreman carries a rail square which he tries on every third or fourth joint. Rails must be measured carefully with a wooden rod or steel tape, and the longer ones marked so that they can be easily distinguished. When joints run out of square, the long rails must be used all on one side till the joints become again square. Thicker expansion shims should *never* be used in order to square up joints. In laying track with broken joints (which is the more common practice both on tangents and curves) the question of the relative position of joints is not so important. If the joint lacks 6 inches or a foot from being opposite the middle of the opposite rail, no harm is done, while if in laying matched joints they get 6 inches out of square, the joint ties will be badly slewed. Another disadvantage of laying track with matched joints is that the rail square will not tell the exact truth unless the rails are nearly to line and gauge. A small kink on the line side may throw the gauge end of the square an inch or more from the proper position for the joint.

The foreman will generally have to instruct his assistant as to the proper thickness of shim to use, and when to change to a thicker or thinner size. The temperature of the steel is what should govern, and not the temperature of the air. The temperature of steel, in general, lags below the air temperature in the morning, and loses its heat less rapidly than the air in the afternoon. If a subgrade is rough and uneven a greater allowance should be made for expansion as the track will shorten when brought up to surface. The track laid should be lined at the end of each day to prevent shortening. The track laid in one day will move ahead when the short kinks are lined out, but if lining is neglected for several days the weight of the track becomes too great to move ahead, and all lengthening caused by kinks being straightened will be made up by a decrease in the expansion.

In case the number of men is too small to organize completely for all the necessary operations in track laying, some of the work can be done before starting to lay track. Peddling material, fiddling and lining ties may be done beforehand. Spiking can be partially done while setting up the steel and back bolting can be done after the steel is set up and gauge spiked. Track should be jointed up and gauged when laying, in order to obtain correct expansion. If rails are set up and the angle bars not put on, it is impossible to keep some of the expansion shims from falling out, and the ends of rails are liable to run past and necessitate shifting a number of them, when jointing up later. Before gauging, joints should be thoroughly tightened in order to prevent bad gauge or lips.

The foreman is responsible for both the quantity and quality of work done. He must organize the gang, and must be ready at any time to make changes necessary on account of the absence of laborers. If a number of men leave at the same time and new men are not available, the whole gang must be reorganized. As the assistant foreman's time is constantly taken up by the rail gang, the foreman must supervise the spiking and back bolting as well as inspect the work of the assistant foreman, as he is also responsible for his work. Assistant foremen sometimes obtain their positions through favoritism. This is bad policy for such a man is generally incompetent and arrogant, realizing the fact that it is probably impossible for the foreman to discharge him. With such an assistant foreman,, discipline is hard to maintain, and without discipline and organization a gang can not be efficient.

MEETING OF ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION.

The Twenty-Ninth Annual Convention of the Roadmasters and Maintenance of Way Association will be held at St. Louis, September 12, 13, 14 and 15.

Last year's convention was the most profitable one in the history of the association, and the coming meeting bids fair to rival it in interest and attendance. That the association is thoroughly alive is proven by the large number of new members joining last year; the increase in membership was nearly 40 per cent. The officers of the association are:

President—T. Thompson, A., T. & S. F. Ry., Joliet, Ill.

First Vice-President—L. C. Ryan, C. & N.-W., Sterling, Ill.

Second Vice-President—D. E. Lynch, C., B. & Q., Alliance, Neb.

Secretary-Treasurer—W. E. Emery, P. & P. U. Ry., Peoria, Ill.

The committees appointed for 1911 are as follows:

More General Use of Manganese Steel for Frogs, Crossings and Switches.

M. Burke, Chairman, C., M. & St. P., Chicago, Ill.
T. Thompson, A., T. & S. F., Joliet, Ill.
Leo Ryan, C. & N.-W., Sterling, Ill.
T. F. Donahoe, B. & O., Glenwood, Pa.
Jas. J. Duffey, C. & I. W., Chicago, Ill.
J. W. Fletcher, C. & N.-W., Chester, S. C.

Is It Economy to Use Soft Ties for Switches, Switching Leads and Track.

Jas. Sweeney, Chairman, C. & E. I., Danville, Ill.
J. W. McManama, B. & M., Waltham, Mass.
W. H. Heath, C. of Ga., Troy, Ala.
Oscar Gabriel, A., T. & S. F., Albuquerque, N. M.
John McNulty, C., R. I. & P., Waterloo, Ia.
Chas. Newberg, C. & N.-W., Marinette, Wis.

How to Remedy Soft Spots in Road Bed.

M. Henry, Chairman, C. & E. I., Salem, Ill.
W. B. Strother, T. & W., Chester, Va.
Henry Kleine, C. & A., Slater, Mo.
T. H. Gaffney, Mo. Pac. Ry., Wynne, Ark.
J. A. Roland, C. & N.-W., Sioux City, Ia.
A. B. Richards, L. E. & W., Muncie, Ind.

Motor Cars for Section Use.

D. E. Lynch, Chairman, C., B. & Q., Alliance, Neb.
Coleman King, L. Island R. R., Jamaica, N. Y.
D. E. Crowley, C. & N.-W., Milwaukee, Wis.
John Heshion, Mo. Pac., Concordia, Kan.
A. L. Kleine, A., T. & S. F., Marcelline, Mo.
Warren Peachey, E. & T. H., Evansville, Ind.

Concrete and Steel Ties.

L. C. Ryan, Chairman, C. & N.-W., Sterling, Ill.
T. R. Layng, B. & L. E., Greenville, Pa.
P. J. McAndrews, C. & N.-W., Belle Plaine, Ia.
John O'Leary, C. & A., Joliet, Ill.
John D. Boland, Union Pac., Kansas City, Mo.
F. D. Harrigan, Pere Marquette, Saginaw, Mich.

Treated Ties.

J. H. Lynch, Chairman, C., R. I. & P., Chickasha, Okla.
J .A. Turner, B. F. & B. C., Rockland, Tex.
Geo. D. Gifford, N. Y. C. & H. R., Rochester, N. Y.
A. G. Hart, Sou. Pac., Redding, Cal.
J. D. Brunk, K. C., M. & O., Wichita, Kan.
J. L. Single, P. S. Co., Newark, N. J.

Emergency Stock of Tools.

J. H. Jones, Chairman, A., T. & S. F., Topeka, Kan.
M. J. Adams, B. & O., Rockwood, Pa.
F. E. Sampson, B. & M., Concord, N. H.
B. A. West, A., T. & S. F., Pueblo, Col
J. T. Martin, D., T. & I., Springfield, O.
Wm. J. McDermott, C. & N.-W., Eagle Grove, Ia.

New Appliances.

A. M. Clough, Chairman, N. Y. C. & H. R., Batavia, N. Y.
T. Thompson, A., T. & S. F., Joliet, Ill.
D. Foley, Mich Cent., Jackson, Mich.
W. H. Connolly, Cinn. Northern, VanWert, O.
J. M. Meade, A., T. & S. F., Topeka, Kan.
A. W. Tabert, C. & N.-W. Ry., Eagle Grove, Ia.

Topics for Discussion.

Standard for dressing stone ballasted track.

Tie plates versus guard rail braces for holding track to gauge.

Best method for inspecting ties in track for following year's renewals.

Committee of Arrangements.

W. E. Emery, Chairman, P. & P. U., Peoria, Ill.
J. S. McGuigan, St. L. & S. F., St. Louis, Mo.
J. A. Kell, St. L., I., M. & S., St. Louis, Mo.

SCREW SPIKES.

Editor Engineering: We have not as yet used screw spikes on anything except extremely well ballasted track and only on 100-pound rail laid on main lines of the Illinois division. The question you raise with respect to shimming has been considered, and is a very proper question to consider. At the same time, we believe that when the time comes, it may be found that the benefits of the screw spike are so great as to offset any difficulty that may arise with reference to the question of methods and additional expense to shim track which is liable to heave.

It will take a few years, in all probability, to really settle this question. No one can dispute the fact that shimming with screw spikes will be a more expensive job than shimming with drive spikes. At the same time, we can see how the shimming can be made a much better job with less wear and tear of tie.

(Signed) J. B. BERRY,
Chief Engineer, C. R. I. & P.

Editor Engineering:

Our road has not as yet used any screw spikes. I have not heretofore been ready to advocate them, feeling that since with the kind of ballast which we have heretofore used the spring of the rail invariably pulled the spike somewhat, making a space between the head of the spike and the rail, screw spikes could either not be driven down close to the rail or else the tie would be lifted by them off from its bed. I have recently made careful examination of the bedding of our ties on broken stone, however, and have found that they do not work down into it as the ties do into the ballast which we have used heretofore, and consequently, believing that screw spikes can now be driven home, I am ready to advocate their use at least experimentally, with a pretty firm belief that they are going to be a large improvement over the driven spike.

We are not using any other than hard wood ties on our main line, and in these I believe the spikes will hold perfectly well without the necessity for tie plugs, which I am sure are an abomination in that it is necessary before they are inserted in the tie to bore holes for them so large that they can not fail to seriously weaken the tie.

(Signed) SAM'L ROCKWELL,
Chief Engineer, New York Central Lines.

ELECTRIC LIGHTING FOR SIGNALS.

Contracts have been awarded by the Cumberland Valley for electric lighting of its signal system on forty-three miles of double track.

Alternating current at 3,300 volts, 25-cycle, single-phase, will be used. It is the intention in these installations to carry sufficient current in the signal mains to supply electric light at all of the company's stations. This will be the first instance of such use of signal circuits on a steam railroad.

New Books

MANUAL OF THE AMERICAN ENGINEERING ASSOCIATION, 477 pages, third edition. Paper $2.50; cloth $3.00; half morocco $3.50. Published by the American Railway Engineering Association, Monadnock Bldg., Chicago, Ill.

The 1911 (third) edition of the Manual of the American Railway Engineering Association has just been published. This book contains notes "pertaining to the scientific and economic location, construction, operation, and maintenance of railways."

The preface contains the following statement: "It is intended that this volume shall contain results only, but with each subject reference is given to the volume of the Proceedings containing the full committee reports and discussion thereon. The first edition of the Manual was published in 1905, the second edition was published in 1907. Supplements containing changes and additions were published in Bulletin No. 77, September, 1906, and Bulletin No. 103, September, 1908.

In the present edition the entire work of the Association has been brought up to date, each Committee reviewing its own subject matter."

The Manual has a total of 477 pages of matter as compared with 291 pages in the 1907 edition. It is probable that the book contains more important information on the subjects treated than any other publication, for this book contains the important results and conclusions of all the reports of the society since its formation.

Personals

H. R. Clark, assistant engineer of construction on the Chicago, Burlington & Quincy, has been appointed roadmaster of the Aurora division, succeeding E. P. Erickson at Sterling, Ill.

N. Rowe has received an appointment as roadmaster of the Atchison, Topeka & Santa Fe, with office at Newton, Kan., succeeding W. S. Boyce. T. J. Moriarty has been succeeded as roadmaster at Abilene, Kan., by A. W. Ross.

Chas. Morlock has been appointed assistant engineer of the Baltimore & Ohio. His office will be at Philadelphia, Pa.

F. W. Bailey has resigned as superintendent of bridges and buildings of the Missouri, Kansas & Texas, office at Denison, Tex. Mr. Bailey resigns to engage in other business.

F. D. Avery has been appointed assistant engineer of the New York Central & Hudson River, Buffalo division, with office at Buffalo, N. Y.

I. B. Herman, principal assistant engineer, has been appointed acting chief engineer of way and structures of the Southern Ry. and the Northern Alamaba R. R. D. W. Lum, who formerly held the position, retires at his own request Sept. 1. The office is at Washington, D. C. T. H. Gatlin, engineer maintenance of way of the Middle district, has been appointed assistant chief engineer maintenance of way, with office at Washington. R. D. Tobien, formerly assistant engineer at Washington, has been appointed engineer maintenance of way, office at Birmingham, Ala. C. C. Coffee, superintendent, with office at Louisville, Ky., has been appointed engineer maintenance of way of the Middle district, with office at Knoxville, Tenn.

L. L. Ashton has been appointed assistant roadmaster of the Canadian Pacific, District 1, succeeding J. Todd, who has resigned. The office is at Revelstoke, B. C.

Thos. B. Kennedy, formerly trainmaster, has been appointed assistant engineer of the Cumberland Valley, with office at Chambersburg, Pa.

Noah Suloff has resigned as general manager of the Tuscarora Valley, office at Port Royal, Pa.

W. H. de France has been appointed general superintendent of the Louisiana Southern, with office at New Orleans, La.

F. R. Blunt, formerly trainmaster of the Chicago Great Western, has been appointed superintendent of the Western division, succeeding C. E. Carson, transferred. Mr. Blunt's headquarter are to be at Clarion, Ia. C. E. Carson succeeds G. W. Vanderslice as superintendent of the Northern division, with office at St. Paul, Minn.

Wm. N. Neff has been appointed general superintendent of the St. Louis Southwestern, with office at Tyler, Tex., succeeding J. W. Maxwell, deceased.

H. D. Earl has been appointed superintendent of the St. Louis Southwestern Ry. of Texas, succeeding W. N. Neff. Mr. Earl's office is at Mount Pleasant, Tex.

C. D. Purdon has been appointed consulting engineer of the St. Louis Southwestern Ry. of Texas, with office at St. Louis, Mo.

RAILWAY CONSTRUCTION.

The Illinois Central is double-tracking its line from Ponchatoula, La., to Orleans Junction, about 36 miles.

According to reports, the Atchison Topeka & Santa Fe will build a line from Ivanpah, Cal., to the Yellow Pine mining district, near Good Springs, Nev., about 25 miles.

The Pacific & Idaho Northern has plans ready for the construction of the line from New Meadows to Lardo, Idaho, a distance of 10 miles. A contract for this construction will be awarded soon.

The Southern Pacific is considering the construction of a cut-off from Battle Mountain, to Haven, Nev. The estimate for the work is $7,000,000. This cut-off will shorten the road by about 50 miles.

The main line of the New York, Westchester & Boston between New York and Mount Vernon is expected to be ready for operation by the winter of 1911.

The Oregon Short Line has secured the right of way for a double track between Salt Lake City and Ogden, Utah.

The St. Louis & San Francisco is planning to complete the Brownwood North & South which has recently been acquired. T. Yates, Engr. Cons. of the Frisco, has opened an office at Brownwood.

The Pittsburg, Shawmut & Northern is now building a railroad from Knoxdale, Pa., to Freeport, 100 miles, and contemplates building a branch from Nicholson's Run, to North Butler.

The Atlantic Coast line is replacing all light rails with 85 lb. steel, in Georgia. The road is also to be gravel ballasted.

The Missouri, Kansas & Texas, is contemplating building a railway from a point near Bartlesville to Pawhuska and then to Enid, Okla., about 100 miles.

The City of Dayton, Ohio, the P. C. C. & St. L., the C. H. & D. the Big Four and the Erie R. R.are considering plans and details for elevating all the steam railroads through the city of Dayton, at a cost of $3,000,000.

The Chicago, Burlington & Quincy contemplates the construction of about 30 miles of road from Hudson north to Greeley, Colo.

The Union Pacific Railroad contemplates extending its Crow Lake branch north of Briggsdale, Colo., to join the main branch at Pine Bluff, Wyo.

W. Klausmann, engineer, Indianapolis, Ind., has preliminary plans in progress for 3½ miles of track elevation to cost $6,000,000. The following railroads are interested: Indianapolis Union, Pennsylvania R. R., Lake Erie & Western, the Monon and the Big Four.

Depth of Stone Ballast.*

During the years 1887 to 1890, inclusive, Railroad Director Schubert of Germany conducted a series of experiments to demonstrate, "Which ballast material affords the best distribution of force upon the subgrade or roadbed." These experiments were conducted by filling boxes with layers of different kinds of ballast and other material upon which a section of a tie was laid. This tie was then tamped in the ordinary way and subjected, by means of an eccentric, to a load which was alternately imposed upon and lifted from the tie—thus imitating the process of passing a loaded wheel over the track. After repeated tampings and applications of the load the ends of the box were removed and the conditions beneath the tie investigated. One of the conclusions drawn from the experiment was, as the depth of stone ballast under the tie increased, that the distribution of pressure on the underlying material became more uniform.

Apparatus Used in Tests for Depth of Stone Ballast.

The data by Mr. Schubert were very instructive, yet the committee felt that more valuable data could be obtained from a series of experiments if made in a manner approaching more nearly actual track conditions.

Accordingly, at South Altoona Foundries, a piece of single track was constructed under which were placed three strong boxes open at the top and having removable ends, each box sufficiently large to contain two standard ties spaced the standard distance apart; the boxes were filled with various kinds of ballast and roadbed material.

A heavily loaded truck was designed to run back and forth on the track so that the effect of its load acting through the ties upon the ballast and roadbed could be studied by the removal of the ends of the boxes, when measurements and photographs could be taken. The general arrangement of the plant is shown by the photograph. The track was 109 ft. in length, built of new P. R. R. standard 85-lb. rail, spiked to standard white oak ties 7 in. by 9 in. by 8½ ft. long, no tieplates being used. The rail fastenings were standard spikes, and the rail joints were so arranged as not to fall within the limits of the boxes. Eighty-five-pound rail was selected in preference to 100-lb. rail in order that the track might be sufficiently flexible to subject the ties to as much weight as possible. The ends of the track were elevated to facilitate the stopping and starting of the car, but the part over the boxes was level. The boxes were built of yellow pine planking 4½ in. thick by 8 in. wide and had floors of the same material resting on sand several inches deep, which, in turn, rested on an undisturbed shale formation. The site was selected to provide a solid bottom to prevent an appreciable settlement taking place in the boxes. The joints between the planks were not tongued and grooved nor sufficiently tight to prevent the passage of water. The boxes were strengthened by an arrangement of heavy posts and the tie rods.

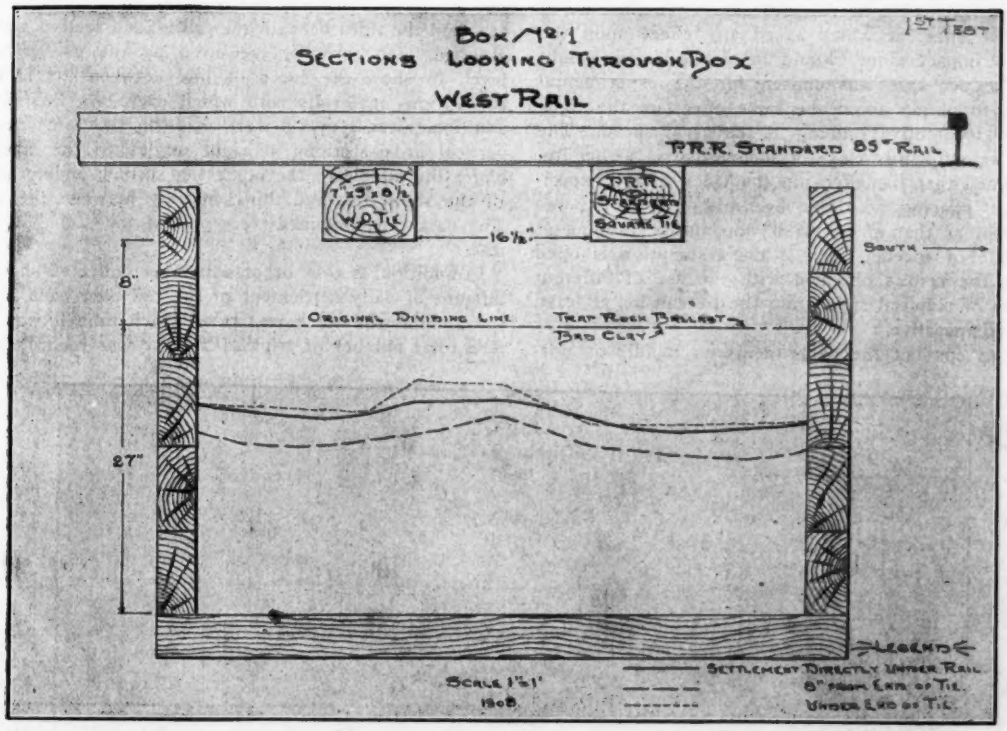
The boxes under the track were 12 ft. apart, center to center. They were alike, and their inside dimensions were as follows: 4 ft. 8½ in. wide, 9 ft. long and 3 ft. 4 in. high, being set so that their tops were 2 in. below the base of the rail.

The testing plant was roofed over to prevent rain from falling on the boxes so that the amount of water applied to the boxes could be accurately determined.

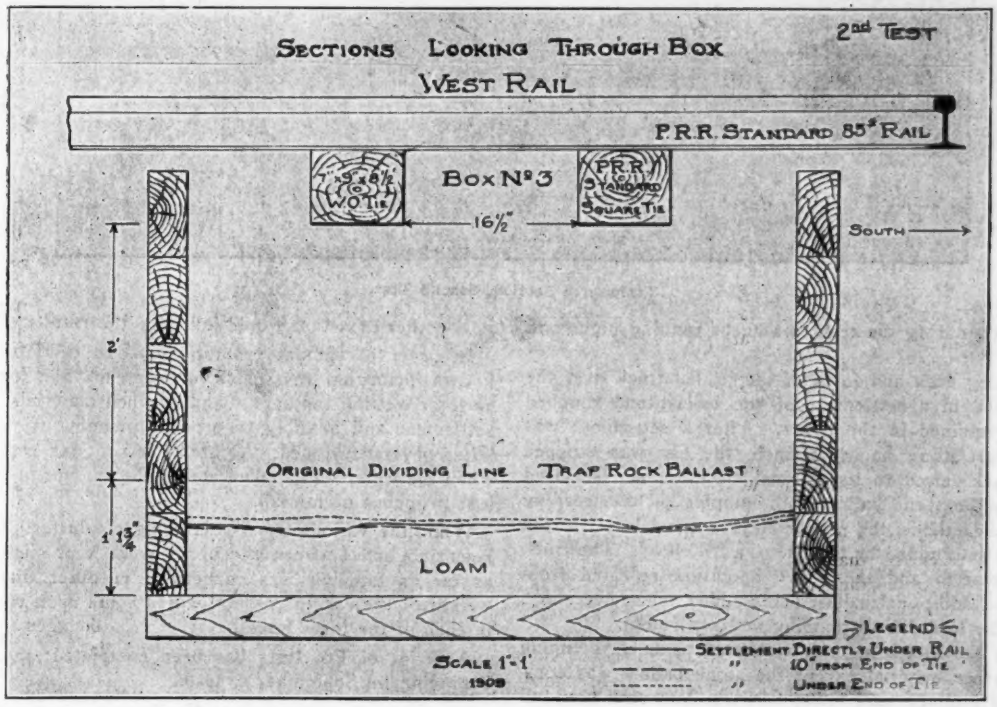
The car or truck having two axles (as shown by the photograph) was designed to run back and forth upon the track at a speed of about five miles per hour. The car had a wheel base of 9 ft. and was loaded with pig iron, so that the gross weight amounted to 150,000 lbs., or 75,000 lbs. per axle. There was no spring intervention between the weight and the axle, the journal boxes being fastened directly to the body of the car.

The car was kept moving by an electric motor geared to one axle, the current being supplied through an overhead shoe bearing against a conductor. At the elevated end of the track a device automatically shut off the current

*Extracts from Committee Report, Bulletin 136, American Railway Engineering Association.



Longitudinal Section, Completion of First Test; 8 Inches of Rock Ballast on Clay Subsoil.



Longitudinal Section, Second Test; 24 Inches of Rock Ballast on Loam.

and reversed the motor; the car needed very little power or attention to keep it in motion. A counter on the car registered the number of trips made.

It being impracticable to run the car faster than about five miles per hour, at which speed any effect upon the track due to impact alone, would be negligible, a weight of 75,000 lbs. per axle was chosen for the experimental truck, so as to obtain about the same effect on the track as an "H8b" locomotive running at the usual speed. The weight per axle for this class of locomotive is 58,100 lbs. It was assumed that the effect on the track of the experimental truck, running at about five miles per hour, was about as great as that of an "H8b" locomotive running at the usual rate of speed. Even if the assumption is open to question, the results obtained with the use of different combinations of material supporting the tie can be, at least, considered comparative.

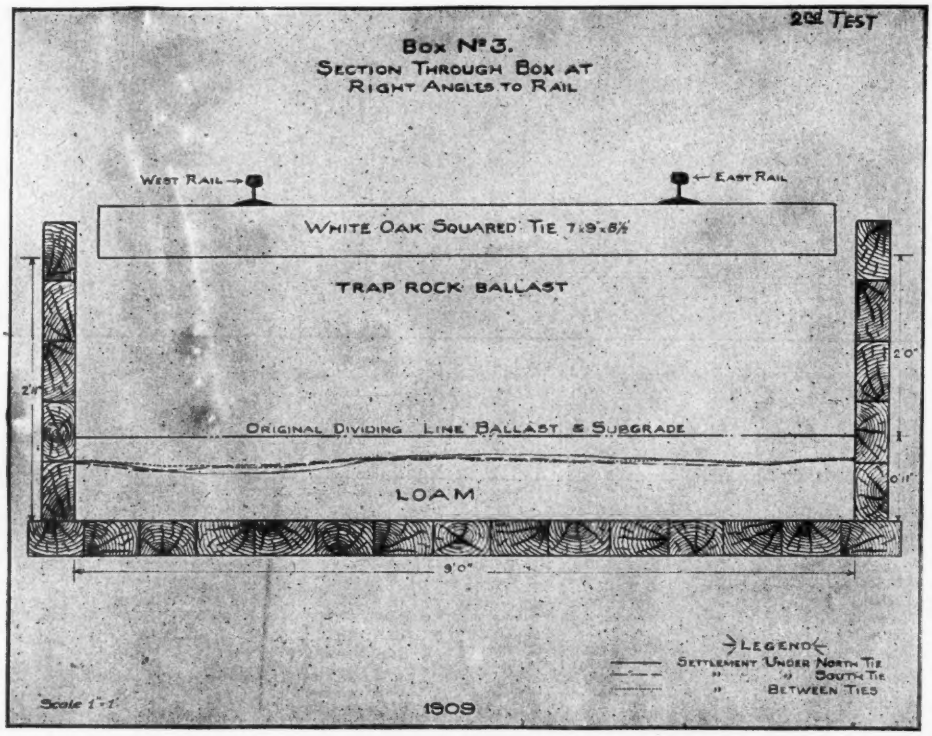
In order to conduct the experiments as rapidly as possible, the car, during the tests, was kept running night and day.

The running back and forth of the loaded truck over the track resulted in a settlement of the ballast and roadbed materials contained in the boxes. After a settlement was noticed, aggregating about an inch, the car was stopped and the track raised to its original elevation and surfaced by tamping the stone ballast with tamping picks according to the usual methods, the proper elevation and levels of the track being determined by the use of a "Y" level. The truck was then started and the above operation repeated from time to time, additional ballast being added, when necessary, to supply the loss due to tamping and settlement.

In filling the boxes in each test, the loam, clay, engine cinder or other material except the stone ballast was compacted by a rammer, care being taken to ram each box and each kind of material as nearly alike as possible.

The truck was kept running and the accumulated results were noted until the decrease in the daily settlement was so marked that it was considered time to close the test, when the boxes were opened and at each end three vertical sections parallel with the rail were cut in the ballast and roadbed materials; the first was taken at the end of the tie; the second half-way between the end of the tie and the rail, and the third beneath the rail. Each section was photographed, also carefully measured by the use of the "Y" level, to show the curve or line between the ballast and the various materials with which each box was filled. In addition, measurements were made in the same manner of vertical cross-sections at right angles to the track; first, under the middle of the north tie; second, under the middle of the south tie; and third, midway between the two ties. The data thus obtained were plotted for each box, in each test.

In addition to this, other data were collected showing the amount of daily settlement of the rail over each box; also, the amount the track was raised each time it was tamped. The total number of trips of the car was recorded, as well as all other data that would influence the results obtained.



Transverse Section, Second Test.

In order to simulate conditions as to rainfall, water in known quantities was sprinkled over each box for the purpose of wetting the ballast and roadbed materials, to induce settlement and possibly to produce pumping track, but the latter never developed. A careful record was kept showing when the water was applied and of the amount in its equivalent in inches of rainfall.

While the various tests were being conducted the ties adjacent to and between the boxes were kept slightly loose, as far as tamping was concerned, in order that the full weight of the car, in passing, would come upon the two ties in each of the three boxes.

A series of five tests has been completed; the first one beginning on September 2, 1910.

Test No. 1.

In filling the boxes for the first test it was determined to use 8 in. of standard trap rock ballast beneath each tie, 8 in. of ballast being standard for single track. Beneath

the ballast in one box were 27 in. of yellow clay from Neff's Cut on the Middle Division (Penn. R. R.), which had proved itself a very bad and unstable material for roadbed purposes. In the second box, beneath the 8 in. of trap rock ballast, were placed 27 in. of good sandy loam, and in the third box, beneath the 8 in. of trap rock ballast were placed 12 in. of engine cinder, and below that 15 in. of yellow clay, the same as in the first box. The track was then surfaced by the use of tamping picks, brought up to grade and the boxes filled with standard trap rock ballast to the top of the tie. The car was started and elevations taken from time to time to note the settlement, and the track was raised when required, as before described.

After the car has made about 4,000 round trips, water was applied by sprinkling it equally over each box, first applying each day an amount equivalent to one-half inch rainfall.

After a few days the amount was increased to 2 in. each day and continued daily for quite a period, when the amount was increased to 4 in. per day for about a week, then 8 in. per day applied for two days, in the hope of producing pumping track, but this was not accomplished for the reason that the water found its way out between the cracks of the planking about as fast as it was put in.

The car having made 81,600 round trips and the track over the boxes being nearly stationary, that is, settling very slowly, it was decided to close the test.

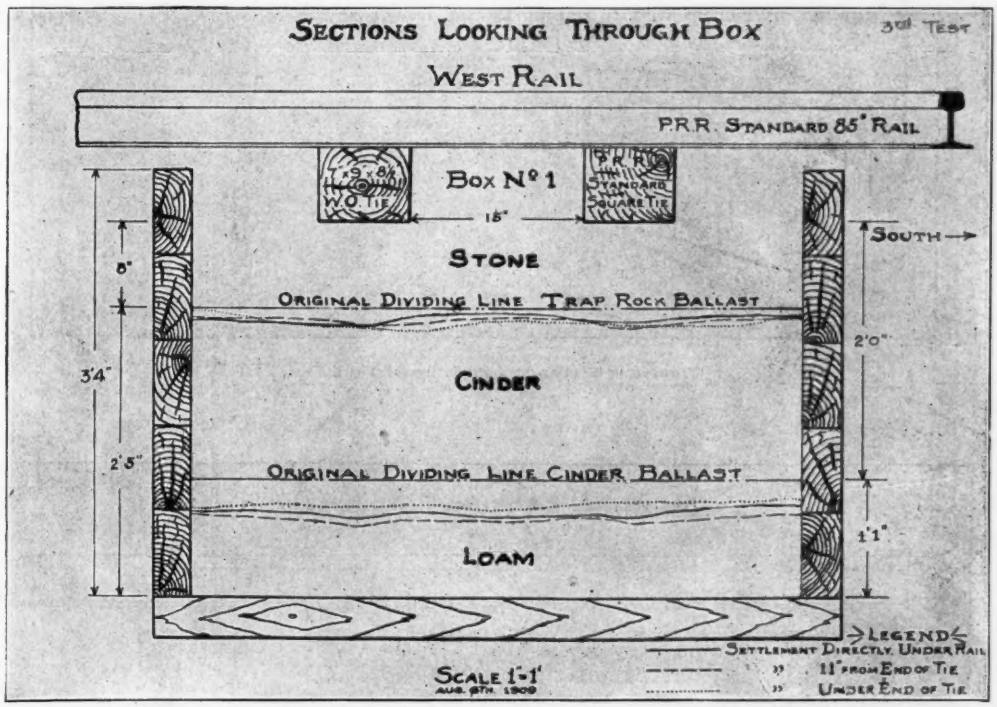
The track over box No. 1 had settled a total of 10 9/16 in.; over box No. 2, a total of 14 1/16 in., and over box No. 3, a total of 10⅝ in. Water equivalent to a rainfall of 98¼ in. had been sprinkled over each box during the test. After the ends of the boxes were removed, sections and photographs were taken.

An inspection of the boxes showed that in every case the depth of the ballast beneath the bottom of the tie had been matterially increased, due to the compression of the roadbed material and the sinking of the ballast into the material beneath it.

Further, the line of demarkation between the bottom of the ballast and the roadbed material was not straight, the ballast having formed a saucer-like depression in the roadbed material beneath each tie under each rail.

In box No. 3 the original 12 in. of engine cinder, between the bottom of the ballast and the top of the clay, was very considerably compressed, the bottom of the ballast immediately under the rail being forced about half way through the cinder. On the other hand, the clay beneath the cinder showed very little compression and the line of demarkation between the bottom of the cinder and the clay was quite straight, while the line between the bottom of the ballast and the top of the cinder was very much depressed under each tie.

The test showed conclusively that a depth of 8 in. of standard trap rock ballast, when laid on the usual roadbed material, was not sufficient to distribute the weight carried by the ties uniformly over the roadbed.



Longitudinal Section, Third Test; 8 Inches Rock Ballast, 16 Inches Cinder Sub Ballast.

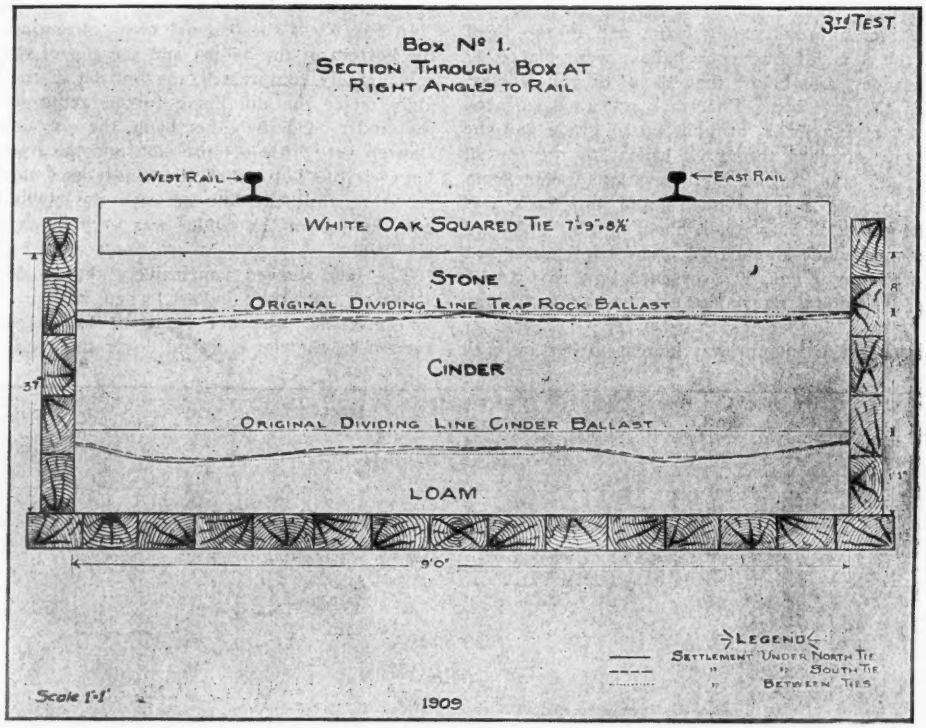
The results in the third box showed, however, that if 12 in. of permeable material, such as soft coal engine cinder, were used beneath the 8 in. of ballast, the distribution of the weight over the roadbed material was much better.

The results of the first test led to the conclusion that a second test should be conducted to determine how a depth of 12 in., 18 in., and 24 in. of trap rock ballast under the ties would behave.

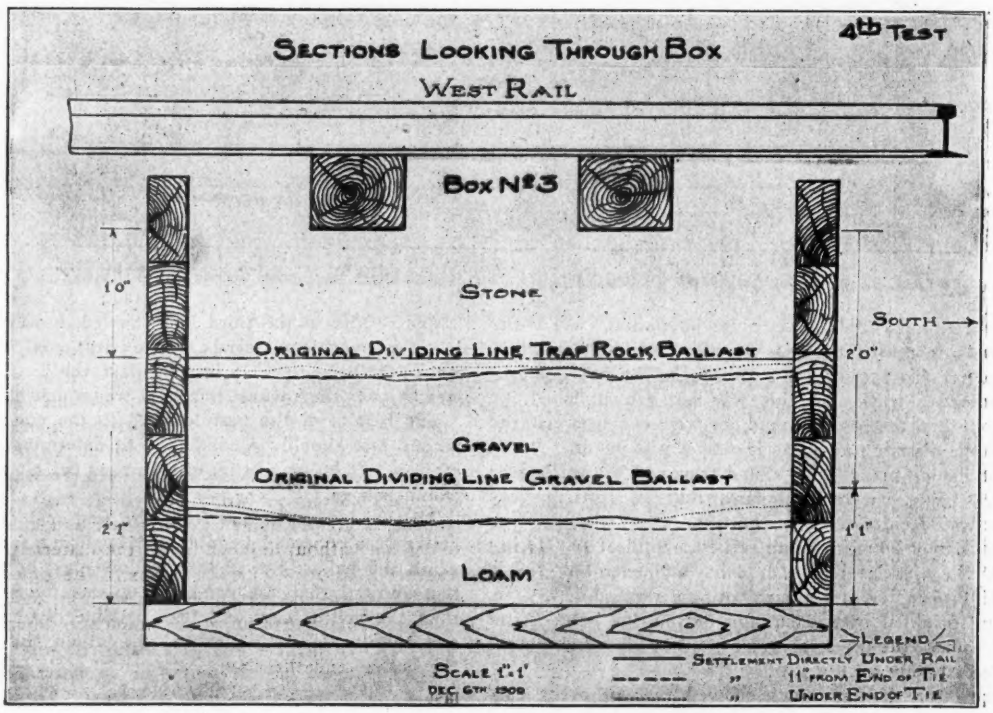
The experience gained from the first test suggested that better results would be obtained by using sandy loam beneath the ballast rather than yellow clay, because the first test showed that the sandy loam was more compressible than the yellow clay and that the line dividing the ballast and the loam was easier to study than the line dividing the ballast and the clay.

Test No. 2.

The boxes were again filled, No. 1 box having 12 in. of trap rock ballast beneath the tie, with 26 in. of loam underneath it; box No. 2 having 18 in. of ballast under the tie, with 19 in. of loam beneath it; and box No. 3 having 24



Transverse Section at Completion of Third Test.



Longitudinal Section, Fourth Test; 12 Inches Rock Ballast, 12 Inches Gravel Sub-Ballast.

in. of ballast under the tie, with 14 in. of loam beneath it.

The car was started running on April 18, 1909, and practically the same method was pursued as in test No. 1, already described. During the test, water equivalent to 11¾ in. of rainfall was applied. After the car had made 49,932 round trips, it was stopped on June 15, 1909, because the track over the boxes settled very slowly. The boxes were opened and photographs and measurements made.

An inspection of the boxes clearly showed that in box No. 1, having 12 in. of ballast beneath the tie, the lower surface of the ballast had been compressed a considerable distance into the loam, and that the line dividing the two was far from straight, there being a considerable depression in the line beneath each tie, especially under the rail.

In box No. 2, where there were 18 in. of ballast originally under the tie, the ballast had not been driven so far down into the loam and the dividing line was much straighter.

In box No. 3, having 24 in. of standard trap rock ballast beneath the tie, the amount of ballast settlement was still less and the line between it and the loam quite straight.

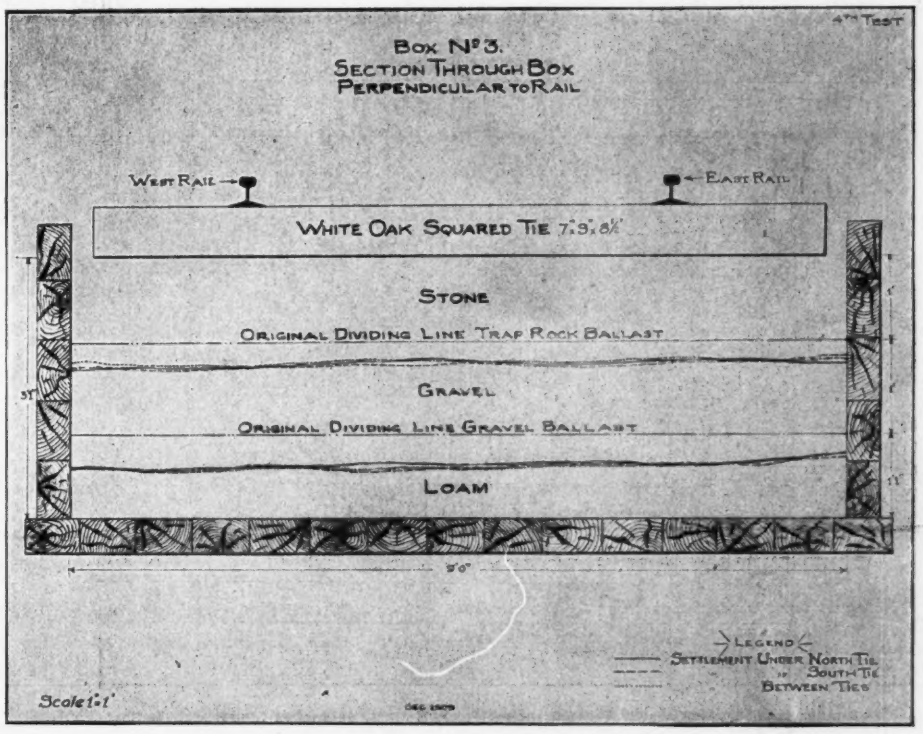
In test No. 2, measurements were taken to show cross-sections at right angles to the rail, one through the middle of each tie and one through the center between the two ties.

Photographs and elevations taken at the time of opening the boxes show that the loam in box No. 1 received the greatest pressure directly under the ties, thereby causing unequal settlement of the loam and the formation of hollows under the ties. This effect was noticeable in box No. 2, but to a less degree, and in box No. 3, with 24 in. of stone ballast, the pressure was so evenly distributed over the loam that only a very slight cupping effect was noticed By taking elevations through the boxes at right angles to the track it was found that the greatest elevation existed along a line parallel to and equidistant from the rails. From this line the surface of the loam inclined towards the ends of the ties, with a cupping directly under the rails. Box No. 3 showed the most uniform surface of sub-grade.

It was found that the water had not penetrated the loam to a greater depth than three or four inches and at the time of investigation trickled out over the sub-grade in small streams.

An inspection of the sections confirmed the conclusion already reached, as these sections show that the deeper the ballast, the straighter the line between it and the loam.

After a careful consideration of the data presented by the second test, the conclusion seems inevitable that with standard stone ballast nothing less than 24 in. beneath the tie will distribute the weight of the load uniformly over the sub-grade or roadbed. On the other hand, test No. 1 had shown that a depth of 8 in. of stone and 12 in. of cinder gave apparently fair results in distributing the weight upon the sub-grade.



Transverse Section, Fourth Test.

Test No. 3.

It was therefore decided to fill No. 1 box with 24 in. of cinder beneath the ties and 12 in. of loam below that; No. 2 box and No. 3 box the same; to run a number of trips over each box and then remove from No. 1 box 8 in. of cinder beneath the tie and substitute for it 8 in. of standard trap rock ballast; in No. 2 box to remove 12 in. of cinder and substitute for it 12 in. of ballast and allow No. 3 box to remain without any change in the materials and then run a number of trips over each box. The object in running on the engine cinder before putting in the stone ballast was to compact it in a similar manner to actual service conditions when the track is first ballasted with engine cinder and later raised out of the cinder upon standard stone ballast.

No. 3 test was started on June 28, 1909, and when the car had made 45,500 round trips it was stopped and the cinder

removed and stone ballast put in boxes Nos. 1 and 2, as described above.

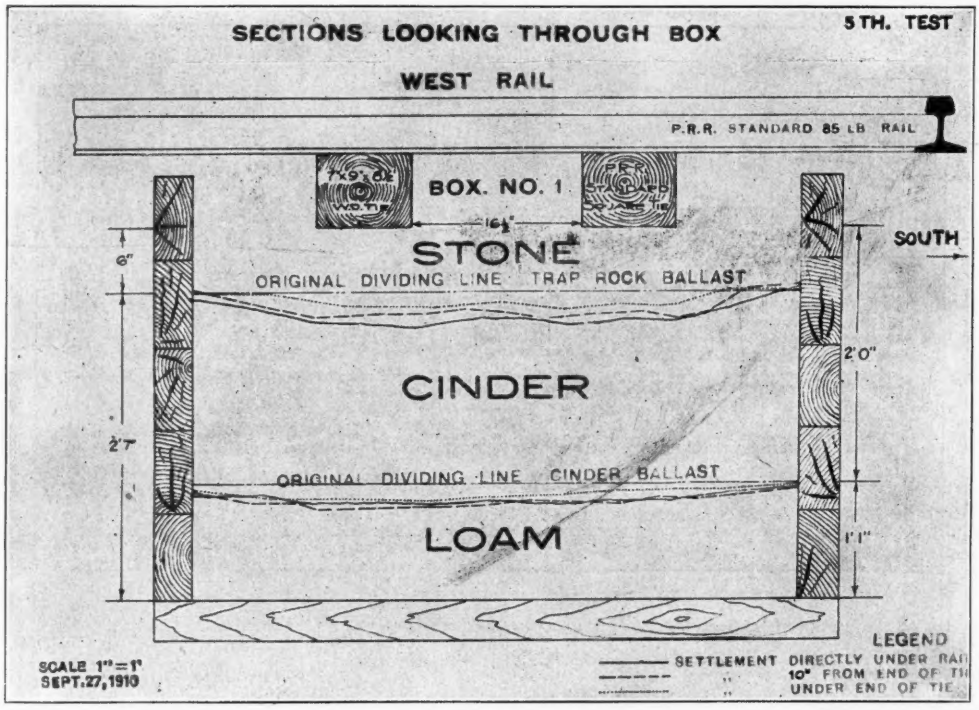
The car was then started and 40,100 round trips were made, water being applied at a rate equivalent to about one-half inch of rainfall per day until a total of 15¾ in. had been sprinkled over each box.

In the previous tests it had been noted that the water found its way through the stone ballast to the top of the clay or loam beneath it and there collected and ran through the cracks between the planks.

In making the third test a new feature was introduced in one of the boxes by placing therein, on top of the loam, beneath the 24 in. of cinder, two pieces of iron pipe perforated with many holes. Each piece of pipe sloped from the center of the box outward to the ends of the box, a slot being made in each end of the box opposite the end of the pipe, so that it could be watched.

separating the engine cinder and the loam, showed that in box No. 3, where cinder was continued through the entire test and no stone ballast substituted, the line between the cinder and the loam was the straightest or best, showing the least amount of cupping, and that the line between the cinder and the loam in boxes Nos. 1 and 2 left very little to choose between them, with a difference, we think, slightly in favor of box No. 2. At the same time it should be clearly noted that the sections taken at right angles to the track show the ties bent more in box No. 3 than they did in either boxes No. 1 or No. 2, due to the fact that engine cinder is more compressible than broken trap rock.

A study of the lines of demarkation, between the trap rock ballast and engine cinder in boxes Nos. 1 and 2, develops that there was less deformation of cupping of the cinder beneath the ties where the depth of stone ballast had originally been 12 in. in box No. 2 than where 8 in. in box No. 1.



Longitudinal Section, Fifth Test; 6 Inches Rock Ballast, 18 Inches Cinder Sub-Ballast.

When the test was started, on June 28, 1909, water equivalent to one-half inch of rainfall was applied daily. This was in progress for nine days, until water equivalent to a total rainfall of 4¾ in. had been sprinkled on box No. 3 before any moisture appeared at the ends of the iron pipe, and then only a very small quantity of slime began to ooze out at the ends. At no time during the test did water run freely from the ends of these pipes. This was considered a very significant fact, inasmuch as it showed the ability of engine cinders to absorb and dissipate a large amount of water falling upon it before the water was able to reach the sub-grade in sufficient quantities to do damage by saturating it. During the experiments the pipes were carefully watched and kept clean from the inside, so that any water reaching them could be observed.

On August 6, 1909, after 85,600 round trips had been made and water equivalent to 15¾ in. of rainfall had been sprinkled on each of the boxes, they were opened, sections measured and photographs taken.

A study of the sections and photographs as to the line

Test No. 4.

It was determined upon the conclusion of test No. 3 that it would be well to test two other materials available for use as sub-ballast, namely, granulated slag and gravel, to see how they would compare with engine cinder under similar conditions. Therefore test No. 4 was started, boxes Nos. 1 and 2 having 24 in. of granulated slag under the ties and 12 in. of loam beneath that; box No. 3 having 24 in. of a sandy New Jersey gravel procured along the Bonhampton Branch of the New York Division. After the boxes were filled practically the same method was pursued as in test No. 3. It was noted that the compressibility of gravel was about equal to that of engine cinder, while that of granulated slag was much greater.

After 45,561 round trips had been made by the car, boxes Nos. 1 and 2, respectively, had 8 in. and 12 in. of trap rock ballast put in beneath the ties and on top of the granulated slag, while box Nos. 3 had 12 in. of standard trap rock ballast put in on top of the gravel. The car was again started and run for 40,060 round trips.

After a total of 85,621 round trips had been made and water

equivalent to 14 in. of rainfall had been sprinkled over each box, the car was stopped on December 3, 1909, the boxes opened, sections measured and photographs taken, as before described.

This test developed the superiority of gravel when used for sub-ballast, as compared with granulated slag, the granulated slag being much more compressible and unstable than the gravel. There was little difference, however, in the line dividing the slag and the loam, and the gravel and the loam. This would seem to indicate that neither material had much advantage over the other in distributing the pressure upon the loam. A further study of this line showed that in box No. 2, where, during the latter half of the test, there were 12 in. of trap rock ballast beneath the tie, the line between the slag and the loam was a trifle better than where there were only 8 in. beneath the tie in box No. 1.

An inspection of the line, dividing the trap rock ballast and slag in boxes Nos. 1 and 2, and the ballast and the gravel in box No. 3, showed that there was more cupping or deformation where the ballast was only 8 in. deep beneath the tie on top of the slag than where it was 12 in. deep beneath the tie on top of the slag or gravel.

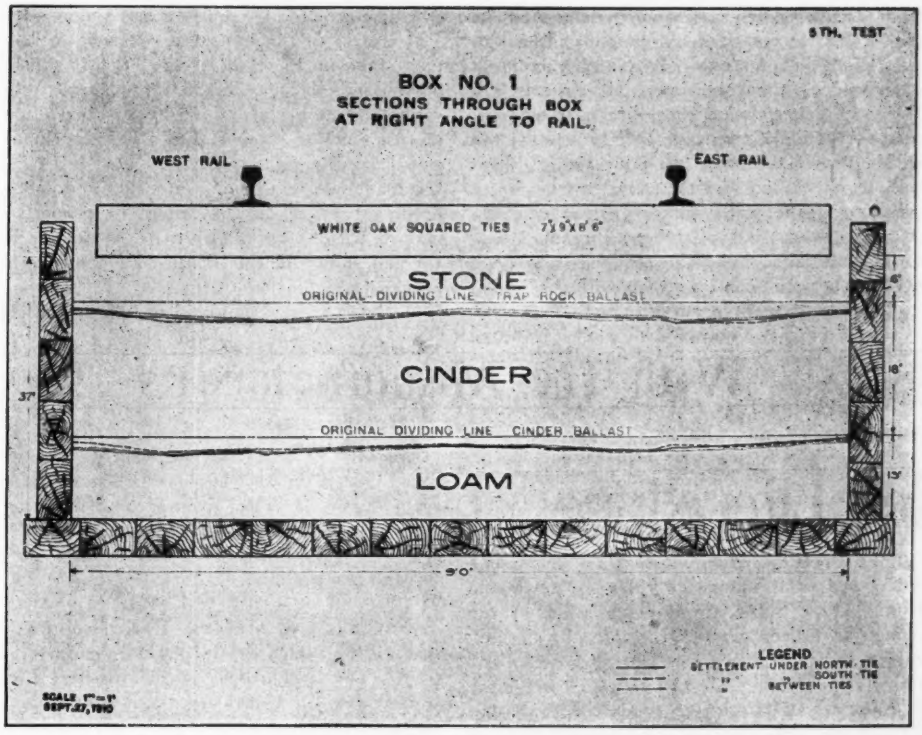
Further, the line in box No. 3, between the trap rock ballast and the gravel, was still better than between the stone ballast and the slag in box No. 2. This is also confirmed by an inspection of the sections taken at right angles to the track.

Test No. 5.

The data obtained from all of the tests up to this point indicate that the greater the depth of trap rock ballast, beneath the tie, at least to a depth of 24 in., the less deformation there is in the line dividing the trap rock ballast and the material directly beneath it, the best results in this respect having been shown with a depth of 24 in. of trap rock ballast beneath the tie in box No. 3 of the second test. This brought forward the proposition whether it would be possible, by a combination of trap rock ballast and engine cinder, having a total depth of 24 in., to get as good a distribution of weight or pressure on the loam as was obtained by a depth of 24 in. of standard trap rock ballast alone. And, further, would such a combination of standard trap rock ballast and engine cinder show too much deformation of the line separating the stone and the engine cinder?

To determine this, if possible, test No. 5 was started with 24 in. of engine cinder beneath the ties on top of 13 in. of loam in each box. The car was started running on May 19, 1910, and 19,210 round trips made to compact the engine cinder until the daily settlement of the cinder amounted to very little.

On June 24, 1910, the car was stopped and 6 in. of standard trap rock ballast was placed beneath the ties in box No. 1, 8 in. beneath the ties in box No. 2, and 10 in. beneath the ties in box No. 3. The ballast was tamped with tamping picks as in all the previous tests. The car was run until a total of 112,304 round trips had been made and water equivalent to a rainfall of 18½ in. had been sprinkled over each box. On August 2, 1910, the car was stopped, the track having, for several days prior, shown very little settlement. The boxes were opened, and the usual measurements made and photographs taken.



Transverse Section, Fifth Test.

The fifth test showed that there was less total settlement in box No. 3, where the depth of the stone ballast was the greatest, namely, 10 in. beneath the tie. Also, that there was less deformation or cupping between the line of engine cinder and the loam, and between the line of ballast and the engine cinder, but the line between the engine cinder and the loam in box No. 3 was not as good as the line between the ballast and the loam in box No. 3 of test No. 2, where there were 24 in. of trap rock ballast beneath the tie and on top of the loam. This indicates that 24 in. of trap rock ballast beneath the tie will distribute the pressure upon the sub-grade more uniformly than a like depth of trap rock ballast and compressed engine cinder combined, up to the

point where the layer of engine cinder has a thickness of not less than 14 in., and it is our opinion that any layer of engine cinder, having a depth of 14 in., would be sufficient to produce the results desired by the use of engine cinder, viz., a layer of material beneath the stone ballast which will absorb, lead off and dissipate water falling upon the track before it can reach the original subgrade in sufficient quantities to be injurious.

A depth of 24 in. of standard trap rock ballast, beneath which is an additional layer or mat, 24 in. thick, of good permeable material, will place our sub-grade at a depth below the average frost line obtaining in the latitude in which the greater part of our (Penn.) system is located, thereby eliminating the trouble due to the action of the frost upon the roadbed and track.

Conclusions.

Since the amount of wear and tear imposed on the experimental track and sub-soil during the various tests was very small compared with that to which our main line tracks are subjected under service conditions, your committee recommends the use of 24 in. of stone ballast underneath the ties to meet satisfactorily the conditions that exist to-day and which will probably become more severe as time goes on; in addition to the 24 in. of trap rock ballast beneath the ties, there should be provided a layer of engine cinder gravel or an equivalent, to act as an absorbent mat to promptly and properly dispose of the water falling on the track in such a manner as to prevent its softening the roadbed material. Where the material forming the roadbed is of poor quality, the mat of engine cinder or gravel will also prove advantageous to prevent its working up into the ballast.

MAINTENANCE.

Editor Engineering: Increasing weight of rolling stock, as well as increased high speed,is constantly making track maintenance more difficult.

Road beds constructed 25 or 30 years ago, unless improved, will scarcely be found satisfactory for present traffic, as in many cases fills are built too narrow and without sufficient slope; no particular trouble was experienced until the weight of rolling stock had been increased 125 per cent, and speed correspondingly.

I have experienced considerable trouble with track settling on fills in locations where the sub-grade was composed of slippery clay, and have overcome this difficulty by depositing additional material in sufficient quantities to make the slope 1½ to 1. I kept the material well down at the base of the fill and of sufficient width on top to properly hold and take care of ballast. The cheapest and best way to handle material is to unload with a side ballast plow and to level back with a ballast spreader. I find that widening has very satisfactorily arrested the settling and sliding of embankments.

It is also of the utmost importance to remove water that may stand on the right-of-way; this is sometimes caused by borrow pits being excavated too deep. Where such water cannot be properly drained by an open ditch or by the use of tile, the low ground should be filled in to prevent water standing on the right-of-way.

Cuts should be of sufficient width and depth to afford good drainage; where ditches cannot be properly maintained tile may be used to good advantage. Drainage is the prime factor and should be one of the first considerations in the economical maintenance of track.

Roadmaster, Michigan Central.

With The Manufacturers

New Literature

The United States Electric Company, New York, has issued in its bulletin No. 502 some suggested rules for telephone train dispatching. These rules are a compilation of the requirements which have been generally adopted by the majority of American railways which have installed telephone train dispatching. As reflecting the consensus of judgment of users, these rules are of interest to roads contemplating the change to telephone dispatching. Some general instructions governing the use of the telephone in railroad service follow and it is believed that, as simple as some of these appear, they have an important bearing on the efficient operation of a railway telephone installation.

* * *

Circulars 11 to 20 which are published by Peter Gray & Sons, Boston, Mass., give descriptions of a large number of lanterns and lamps for various purposes. The results of a number of tests are given for candle power, oil consumption and endurance of high velocity winds. Bulletin 34 has descriptions and illustrations of this company's large line of oil cans and water coolers.

* * *

Catalogue No. 10 of the Verona Tool Works, Pittsburg, Pa., contains a full page half-tone illustration of the immense plant of this company. A number of pages are given over to a description of the manufacture of the Verona spring nut locks. The assortment of track tools is very complete, and the text is illustrated by a profusion of cuts. The price list of all tools is appended and this makes the catalogue of unusual value.

Graphite Products for the Railroad is the title of a catalogue gotten out by the Joseph Dixon Crucible Co., of Jersey City, N. J. The advantages of graphite for lubrication are gone into thoroughly. A smaller pamphlet goes extensively into the properties and manner of manufacture of Dixon flake graphite.

* * *

Catalogue No. 4 of the Hart Steel Co., Elyria, O., describes the styles of tie plates manufactured by this company. The book comes in an attractive form, with an embossed cover. Dimensions and illustrations are given of shoulder plates, flat top plates, and special plates for screw spikes. In addition to tie plates, spikes are listed in the booklet.

* * *

The Weir Frog Company's catalogue No. 8 is attractively bound in linen and contains 289 pages of description and illustration covering frogs, switches, crossings, and a large amount of other material for steam and electric railways. A bird's-eye view is shown of a new plant recently completed by the company at East Norwood, Ohio. Several pages are devoted to the arrangement, equipment, etc., of this new plant. Following this are descriptions and illustrations of an immense number of track appliances. Twenty-five pages at the back of the book are given over to practical tables for use in constructing switches, lining curves, etc.

The Delaware & Hudson is said to be planning extensive shop facilities at Watervliet, N. Y., to include a locomotive repair shop, 275 by 300 ft., a blacksmith shop, 100 by 300 ft., a boiler and tank shop, wood-working shop, a thirty-five stall roundhouse and a general storehouse and administration building; total cost $2,000,000.

AUTOMATIC WEIGHT RECORDER.

Two different systems of automatic dial weight recording attachments for railway track scales are: (1) Card recording attachment; (2) Tape recording attachment.

Either of these attachments automatically records the weight of cars moving over the scales, either coupled in the train, or singly as in the gravity system; there are the following advantages over the old method of hand weighing:

1. Greater accuracy.
2. Reduction in expense of handling cars owing to the greater speed at which they can be weighed.
3. The permanent printed record of the original weight of each car to which reference can be made whenever desired.
4. Elimination of shock to equipment and scale due to cutting and spotting cars.

It is claimed that by the use of either of these attachments cars can be weighed three to five times as rapidly as by the old method of beam weighing which is a maximum average of about 50 cars per hour. Using the following figures as an illustration for comparison: The time consumed in weighing 50 cars by beam will be one hour. The maximum time consumed in weighing 50 cars with the attachment is 20 minutes, a saving over the old method of approximately 66 2-3 per cent per month on engine and crew alone, without considering valuable time saved to the weighmaster.

As mentioned above these recorders are built in two styles, one for printing the weight on a paper tape or ribbon, the other for printing the weight direct on a scale card, on which in either case the car number and other necessary data to complete the record is placed by the weighmaster.

By the method of coupled weighing, the train can be pulled over the scale when entering the yard and all cars weighed, thereby eliminating the expense and time of switching out the weighed cars when distributing the cars to proper tracks. By the gravity system the cars can be weighed and switched to proper tracks without any delay to the regular switching operations.

In using automatic attachments the chances for error are greatly reduced and the time necessary for adjusting the poise when each weight is taken is saved. In these devices the pointer turns with a uniform steady movement, and stops at the correct weight. The pointer does not swing rapidly backward and forward several times before coming to rest. If a mistake should be made in reading any weight, it is easily traced on the tape or card, and is readily corrected.

Streeter and Amit Weighing and Recording Co., 140 Dearborn street, Chicago, are manufacturers of the M. & T. type automatic weight recorders, of which the above is a description.

STEEL BINS AND FIRE PROTECTION.

The matter of fire protection is of the utmost importance in every business, but it is a striking fact that thousands of merchants and manufacturers take no cognizance of the necessity of this protection. They are generally disposed to let well enough alone—inasmuch as they have never been burned out.

Disastrous fires, however, have compelled the attention of many business men. Heeding the necessity of protection, they are building steel bulwarks to resist the spread of possible fires. These men demand fireproof buildings because they want their property, their stock, their business thoroughly protected.

In line with the general policy of fireproofing, steel bins are coming into favor for storing small stock of every description in bulk. Hardware dealers and other merchants are using them, while they are being introduced into many factories where it is essential that small parts be kept conveniently at hand. They are constructed of steel and reinforce the other steel construction of the building, for they do not feed flames but assist in the general plan of protection.

One of the biggest manufacturing companies in the great Pittsburg industrial district long ago adopted a plan something like this, of having steel compartments in a great room, protected on all sides with steel—like a gigantic vault—for the storage of valuable blue prints.

The Berger Mfg. Co., of Canton, Ohio, are manufacturers of steel bins for all purposes.

INDUSTRIAL NOTES.

The Hayes Track Appliance Company of Richmond, Ind., has recently placed on the market a new style of derail for use in connection with interlocking work, called model CP. This derail is similar in form and size to model C but has the reversible central eyebolt like model AP. This permits of three connections to the derail. The operating rod is attached to the eyebolt while the facing point lock and wire bolt-lock are attached to the cast lugs. The eyebolt is drop forged and passed through two webs of the derail block. It is reversible and is held in place by double jam nuts.

The United States Light & Heating Co., of New York, has received an order for 100 axle-lighting equipments and national storage batteries from the New York, New Haven & Hartford. Orders have also been received recently from the New York Central, the Erie R. R., the St. Louis & San Francisco, and the Missouri Kansas & Texas.

The Great Northern Railway, which already has nearly 4,000 miles of track equipped with telephone train dispatching equipment, has just placed an order with the Western Electric Company for thirty-two telephone selectors to equip its Cascade Division.

The Steel Car Forge Company, of Pittsburg, have for some time been experimenting with the heat treatment of knuckle pins, with a view of eliminating the large percentage of defective pins. They now have placed upon the market a specially treated pin, superior to the requirements of the Master Car Builders' Association, and in test this pin has shown excellent results as compared with the ordinary open hearth steel pin that has not been treated.

N. S. Reeder, vice-president of the Western Steel Car & Foundry Company, Chicago, has been made second vice-president of the Pressed Steel Car Company, Pittsburgh, Pa., with office in Chicago.

The Winters-Coleman Scale Co., of Springfield, O., has consolidated with the Howe Scale Co. The latter will market their product through the newly organized Automatic Scale Department, Rutland, Vt.

Edward F. Pride has been elected secretary and assistant treasurer of the Standard Coupler Company, New York, succeeding the late Alexander W. Taylor, deceased.

The American Brake Shoe & Foundry Co., is now building a plant on the recently purchased 10 acre track at 26th and S. 46th avenues, Chicago. This will be the largest plant of its kind in the city.

The Parkesburgh Iron Company, Parkesburgh, Pa., has moved its New York offices to 30 Church street.

Hildreth & Co. of New York and Morgan T. Jones Company of Chicago, Inspecting and Supervising Engineers, have formed a combination taking effect August 1st under the title of Hildreth-Jones Company. Mr. Morgan T. Jones will be in full charge of the Western district with headquarters in Chicago.

R. H. Hyland & Co., of Chicago, who is in charge of the western sales of the Mulconroy flexible metallic pneumatic hose, report a period of very satisfactory business. This hose is a seamless, oil proof tube, withstanding a pressure of 1,000 pounds and it is said that it does not peel, crack or kink. No special couplings are required and it is especially adapted for use on a pneumatic hose, withstanding rough usage such as running over it with trucks and bringing it in contract with sharp edges.

Recent Engineering and Maintenance of Way Patents

RAIL CLAMPING CHAIR.

998,010—James W. Jones, Douglas, Ariz.

This device consists of a plate with an integral clamp under which the base of rail is placed. On the opposite side of the rail is a removable clamp, which is bolted to the base plate and holds the rail securely in place.

RAILWAY RAIL BRACE.

998,011—W. A. Keaton and A. Peary, assignors of one-third to A. R. Miller, Houston, Texas.

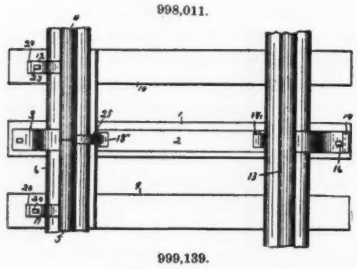
A device including a base plate, an oblong brace carried on and secured to one end, and designed to rest against the outside of the railway rail. A detachable brace is carried by the other end of the plate and rests against the outside of the other rail.

RAILWAY SWITCH.

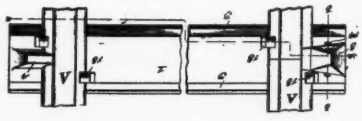
998,098—J. F. Keenan, Philadelphia, Pa.

This switch consists of the usual type of switch points and a frog which is cut off some distance behind the point; just ahead of the point of frog are two movable rails, both connected rigidly to a rod which is operated by a pipe line running from the switch stand. The movable rails move in unison with the switch points and make a continuous track for either route.

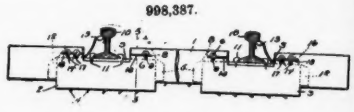
998,011.



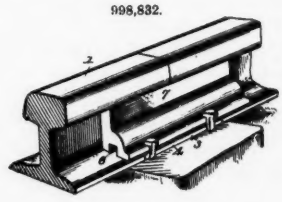
998,669.



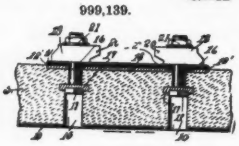
998,387.



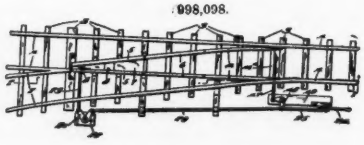
998,832.



999,139.



998,098.



RAILWAY CROSS TIE.

998,387—C. E. Patmore, Fairbury, Ill.

A railway cross tie consisting of a channel section formed with a depression near each end for the reception of a cushioning block to which the rails are fastened; hoods are placed over the blocks, and upturned lips are formed at the edges of the hoods to provide a surface to be bolted to the inside of the channels.

RAILWAY TIE AND RAIL FASTENER.

998,669—Nicholas Bayuk, McKinley, Minn.

This tie has an upper steel face with a protruding lug at either end for engaging the base of the rail. Resting on this lug and fastened to it with a bolt, is a cap which bears against the side of the rail to maintain it in a vertical position.

RAIL JOINT.

998,832—Robert L. Bender, New Cumberland, W. Va.

This device is a rail joint comprising a member having a base portion adapted to fit in the openings which are to be made at the ends in the base flanges of the rails. The base portion has at one side a flange adapted to rest upon the upper surfaces of the base flanges of the rails and bear against the sides of the webs of the rails and against the under surfaces of the heads.

RAIL FASTENER.

999,082—A. J. Alsopiedy, Jeannette, Pa.

A rail joint composed of two angle bars, with holes through which pass bolts for securing the angle bars to the rail. The bolts extend through a hole in one angle bar and screw into a threaded hole in the opposite angle bar. The bolts are provided with holes near the ends, through which a key is to be passed to prevent the bolt turning and loosening. The key passes through a hole in a lug which projects from the upper surface of one angle bar. The key passes through the bolt and the end fits into a hole in the flange of the angle bar.

RAILWAY SIGNAL FUSEE.

999,102—Frank Dutcher, Versailles, Pa.

This patent relates to an improved railway signal fusee, comprising a fiber tube containing a signal compound, the closure having an opening communicating with the tube containing a combustible lighting member extending across the end of the signal compound and closing the opening.

RAILWAY TORPEDO.

999,113—Alfred H. Knapp, Peoria, Ill., assignor to American Fog Signal Company, Pittsburg, Pa.

This torpedo consists of a dome shaped container for the explosive, the container formed of a single piece of pliable material. A flat extension is designed to fit over and close up the base of the dome; the extension is sealed in this position. Means are provided for holding the torpedo to the rail.

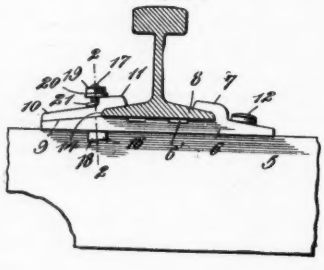
REINFORCED CONCRETE TIE.

999,139—Walter H. Albaugh, Columbus, Ohio.

A railroad concrete tie having square shaped supporting ends, steel collars mounted on these ends and plates embedded in the upper surface of the tie beneath the top portions of the steel collars. Insulation means are interposed between the plates and the top portions of the steel collars. Bolts pass through the tie and hold the rail fastening clamps to the tie.

999,102.

998,010



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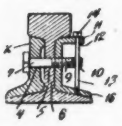

999,113.

General Manager J. P. O'Brien, of the Harriman lines in the Pacific Northwest, announces that the Southern Pacific will at once begin construction of a railroad from Eugene, Ore., across the Coast Range of mountains to Coos Bay. The road will be completed, in two years, at an approximate cost of $8,000,000.

The Newkirk & Powers Co., Joliet, Ill., have work begun on the large contract for the Rock Island, in the elevation of its road in the South Chicago territory from Colfax avenue to the point where the tracks connect with those of the Batlimore & Ohio. This work will take about two years. The company contemplates the elevation of the tracks as far as Blue Island.

The DeQueen & Eastern contemplates building an extension from Dierks to Hot Springs. The name of the new road will be the Texas, Oklahoma & Eastern.

The Southern Pacific will open bids soon for the construction of a branch line from Glamis to the Palo Verde Valley. The first bid will be for the first sixteen miles of the new road, which, when completed, will be a total of 100 miles. W. Hood, San Francisco, Cal., chief engineer.